

Fighting the Pigboats

POPULAR MECHANICS

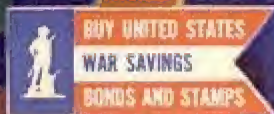
MAGAZINE

WRITE TO US OR STAND IT

READ THIS MAGAZINE IN GREAT BRITAIN, NO. 40428

40¢ U.S. PAY 60¢

JULY
25 CENTS
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SEE PAGE 33

The light in a pilot's eyes

THERE'S something about a perfectly performing aircraft engine that makes a pilot's eyes shine. Unconsciously he is probably reflecting the confidence he places in it.

He undoubtedly does not think of its marvelously ingenious construction, the vital roles played by hundreds of precision parts each with its own specific job to do. No, to him it's one single mechanical marvel, with a distinct personality, which he has learned to know and respect because he has found it dependable in situations involving life or death.

The Champion Spark Plugs we manufacture for use in aircraft engines of every size are built with this in mind. Ours is just one component with one vital job to do in any engine it goes into. But it is a vital product—vital because it must not fail. We never want that light in a pilot's eyes which bespeaks his silent trust in us to be suddenly extinguished by the bitter disillusionment which failure of our product would mean.

That's the kind of responsibility we honestly feel for every Champion Spark Plug made by us—that is the trust we have undertaken and will not fail to meet.



CHAMPION SPARK PLUGS



KEEP 'EM FLYING—BUY WAR BONDS AND STAMPS

**SURE AS SHOOTIN', WHEN IT
COMES TO SYNTHETIC RUBBER,
B.F. GOODRICH GOT THE
JUMP ON EVERYBODY!**



"It was away back in 1940, Bill! I know the B. F. Goodrich folks were selling tires made with synthetic rubber then—because I bought a set. More than half the rubber was synthetic." That's the under-sheriff of Juneau County, Wisconsin, talking. Hundreds of other car owners and companies joined him in helping to get America's synthetic rubber program started. And they did help—by proving that tires made with synthetic could take it. The sheriff's tires went 22,000 miles.



Synthetic rubber keeps 'em rolling. B. F. Goodrich is producing fuel tanks, fuel lines for airplanes and jeep tires with synthetic, to name a few. That's why everybody can't buy synthetic tires today. As this synthetic goes into wartime action the B. F. Goodrich road test of 1940 becomes more important to America.



Your next new car will probably ride on tires made wholly or partially of synthetic rubber. That means you'll be going to a tire dealer again. So remember who made those tires tested under actual driving conditions almost two years before the war. If you do, you'll want to buy yours from B. F. Goodrich—first in rubber.



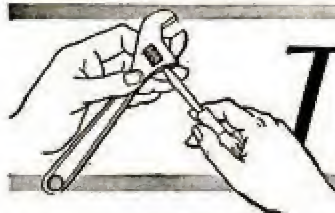
**A few of the many companies that bought
Ameripol tires in 1940 and 1941**

Aetna Life Insurance Co. . . . American Airlines, Inc. . . .
American Can Co. . . . Baltimore & Ohio Railroad . . . The
Borden Co. . . . J. I. Case Co. . . . Gulf Oil Corporation . . .
Geo. A. Hormel & Co. . . . Ingersoll-Rand Co. . . . Kellogg
Company . . . New York Central System . . . New York Tele-
phone Co. . . . Phillips Petroleum Co. . . . Pet Milk Sales Corp.
. . . Railway Express Agency . . . Socony-
Vacuum Oil Co. . . . Standard Brands, Inc. . . .
Swift & Company . . . Western Union Tele-
graph Co. . . . and many other important com-
panies in communities from coast to coast.



In war or peace
B.F. Goodrich
FIRST IN RUBBER





TOOL NOTES

Maintenance
and Repair
Suggestions to
Prolong Tool Life

No. 7 NOTES ON USE AND CARE OF CRESCENT SNIPS

Crescent Snips are made in four styles. The *Standard Pattern* is the most generally used type and is designed for cutting straight lines or circles of fairly large radius. Available in 8 sizes, from 7 to 14" overall length. The *Combination Pattern*, designed after conventional "circular cutting" types, will cut curves as well as straight lines. Made in one size only with an overall length of 12-3/4". The *Heavy Duty Pattern* is a rugged, powerful leverage snip for heavy work. It will cut curves as well as straight lines. One size, 16-1/2" overall length. The *Circular Cutting Pattern* is designed especially for scroll work and intricate patterns. Two sizes, 7" and 12-3/4" overall length.

The terms Right or Left Hand Snips and Right or Left Hand Cut are often confused. A Right Hand Snip has a Left Hand Cut, i. e. it cuts to the operator's left of the top blade, thus enabling a right-handed operator to see the line of cut. The reverse is true of Left Hand Snips. All Crescent Snips are Right Hand Snips.

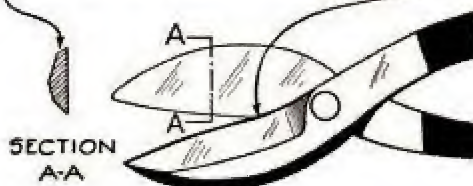


HOW TO USE SNIPS. First mark or scribe the work to accurately locate the line of cut. With the cutting edge of the upper blade directly on the scribed line, begin the cut with the metal well back into the throat of the snips. Stop the cut just before you reach the end of the cutting stroke and repeat the operation by taking another full "bite". If you permit the snip to cut clean through on each stroke, a burred or ragged edge will result and it is more difficult to follow a scribed line. Standard Pattern snips are best for cutting long, straight lines as the flat inside surface of the blade acts as a guide.

When making short cuts of limited length, open the jaws just far enough to permit the desired length of cut. Then cut through with one stroke to the end of the blade. To cut an inside curve, first

drill or punch a hole of sufficient size to permit entry of the blade tip. Then gradually spiral out to the scribed line as indicated in the illustration at left below.

MAINTAIN THIS PROFILE
GRIND BEVELED EDGE ONLY



REGRINDING. The blade contour of Crescent Snips is the result of considerable research and experiment. It is so designed as to present an efficient shearing angle throughout the full length of the cutting stroke. When regrinding, it is therefore important to maintain the original blade contour. Grind only the bevel edge of the blade and only in an amount necessary to restore a clean, sharp edge.

In reassembling the blades, take care not to overtighten the bolt. This caution applies particularly to Crescent U-412 and U-416 snips. Blade tension in all Crescent Snips is attained originally by grinding (not springing) the blades to shape.

COMMON ABUSES. Overloading, by trying to cut stock beyond the capacity of the snip, or forcing the cut by hammering the handles, is poor practice. Cutting wire with snips, likewise, constitutes abuse. This is particularly true with snips having inlaid blades although since Crescent blades are solid forgings and hardened clear through they are less likely to be damaged by this practice. With intelligent use and normal care, Crescent Snips will retain their clean shearing edges for a long time. Keep joint oiled at all times. Prevent rust by occasionally wiping with oiled cloth.

REPAIR PARTS. Bolts and nuts are available for all Crescent Snips. Snip "halves" cannot be supplied as they must be made up in pairs and matched at the factory.

MAIL THE COUPON for free reprints of this series of 10 informative ads. Indicate whether wanted for bulletin board or for 3-ring binder.

.....
Crescent Tool Co., Jamestown, N. Y. A-6

Please send your "Tool Notes" Series
☐ for Bulletins ☐ for 3-ring binder

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CRESCENT TOOLS

Give Wings to Work

CRESCENT TOOL COMPANY, JAMESTOWN, N. Y.

Popular Mechanics Magazine

Registered in U. S. Patent Office and Canada

H. H. WINDSOR, Founder

H. H. WINDSOR, Jr., Editor and Publisher

July, 1943

Vol. 80, No. 1

Next Month

ANNAPOLIS is at war. Among the staff men who are training our future admirals there are veterans of the battles of the Coral Sea and Midway. There is still glamor on the parade grounds of the U. S. Naval Academy, still the time-honored traditions of the midshipmen who toss a penny for luck at the Tecumseh figurehead as they head for an examination in "seamo." But glamor is crowded by hard work from 6:15 a.m. until taps as the boys cram a tough four-year course into three solid years. Visit "Annapolis at War" in the August issue and watch next year's crop of ensigns fire big guns and tin fish in Dahlgren Hall.

Plant Magic

RUBBER plantations in the Mississippi valley? It's not so preposterous as it seems. Tropical cryptostegia, a latex-bearing bush transplanted to California, died of frostbite one night—but one test patch treated with colchicine survived. Perhaps the plant magicians have found a way to breed frost-resistant rubber trees. An August feature, "Plants Grown to Order," reports this and many other miracles of the plant chemists.

Tank Busters

DINOSAURS had their day, but more agile beasts wiped out the clumsy monsters. Now it is the turn of the multi-ton German tank—facing extinction as the fast, maneuverable Yankee tank-busters and the British fighter planes unleash their armor-piercing shells. Our tank destroyers pack the knockout punch, an account in next month's issue reveals.

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Hospitals Under Fire

FIGHTING Yanks get the world's best medical care, and that's no idle boast. In one group of wounded Americans, more than 99 in every 100 recovered. For every 125 fighting men there is a doctor—and an August feature points out that our goal at home is one doctor for 1,500 civilians, while England has a doctor for 2,700 civilians, Germany one for every 12,000 civilians. Blood plasma, the sulfa drugs and an "assembly line" providing quick treatment in the vital hours immediately after injury are three factors in the remarkable medical record our 53,000 military doctors are setting.

"You Can Do It Better With Gas"

FROM an unwanted byproduct that was piped away and let blaze, natural gas has emerged as one of America's richest resources. Dr. Gustav Egloff, noted petroleum scientist, in an article next month tells of the varied uses now made of natural gas—as an anaesthetic, as a quick-ripening agent for fruits, in the manufacture of synthetic rubber and plastics and aviation gasoline. It can be processed into food, or into the most destructive explosive known to man.

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CLEAN OUT THE ENGINE OF YOUR CAR WITH PYROIL



Now, before the heat of summer comes, clean out the engine of your car with Pyroil.

No fussing or bother. Merely add a pint of Pyroil to crankcase oil. Pyroil's benefits work while you drive and while your car is idle. When the oil is drained, you find a cleaned crankcase and a cleaned engine!

**VICTORY
SIZE
3 OUNCES**



Vital inner parts are guarded constantly by Pyroil. First, Pyroil cleans out sludge, gum, carbon and dirt. Unless you take rigid care of your car, these contaminants accumulate easily. But Pyroil keeps them from "gumming up the works!" In addition, the use of Pyroil is a preventive against acid-corrosion and rust.

Summing it all up, Pyroil adds to the life of your engine. Keeps it running smoothly, powerfully, day in and day out.

So, get some Pyroil today at your favorite service station, garage or automotive dealer. Manufactured and Guaranteed by Pyroil Company, W. V. Kidder, Founder, 57 Pyroil Bldg., LaCrosse, Wisconsin, U. S. A.

**Buy Another
War Bond Today**

**MAIL THIS
COUPON**

**DISTRIBUTORS:
CHECK AND MAIL
COUPON FOR FRANCHISE FACTS.**

PYROIL COMPANY
57 Pyroil Bldg., LaCrosse, Wisconsin
Floyd Davis, 500-mile auto race co-winner says, "Pyroil helped keep my engine working great." Fill in this coupon and mail to us for Free folder, "Quick Tune up for Renewed Power with Pyroil." It's interesting.

☐ Send details of your Plan for Distributors

Name

Address

or Town State

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Where no name and address appear directly under an item, the product is not believed by us to be commercially available

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DEATH To Zeros!

MACHINE GUNS
—built by AC since
nine months before
Pearl Harbor.
(Mounted in Martin
bomber.)

AUTOMOTIVE
SPARK PLUGS—
built by AC since
1908.

YOU REMEMBER "Suzy-Q"—famous Flying Fortress that destroyed every Zero attacking from the rear. She was one of the first with .50 caliber tail "stingers"—like those AC has been building *since nine months before Pearl Harbor*.

Aerial gunners know that the shattering blast of those machine guns must be "on tap" all the time. So, those guns are cleaned, oiled, and adjusted after every trip aloft. Marvels of precision workmanship, the guns nevertheless need service to keep them in fighting trim.

Expert Care for Your Spark Plugs

The same thing is true of the AC Spark Plugs which fire the engine of your car, truck, or tractor. Symbols

of quality and performance to millions of motorists; these plugs need cleaning and adjusting every few months. This service is easy to get. Every mechanic—everywhere—renders valuable conservation service. This is being augmented, now, by trained AC service men who are carrying to all service organizations the latest methods of diagnosis and repair of AC products. (The panel below indicates what this service is, and why you need it.) We urge you to follow the simple suggestions—to save gasoline, oil, and tires.

When replacement is needed, select AC—and be sure of complete satisfaction.

AC SPARK PLUG DIVISION
GENERAL MOTORS CORPORATION



Awarded to the men and women of AC on September 2, 1942, for outstanding achievement in producing for Victory.



OIL FILTERS—Slow driving accelerates the formation of soot and carbon in engine oil. If not constantly filtered from the oil, this dirt will clog piston rings, which causes increased consumption of oil and gas. So, replace your oil filter element whenever your dealer's AC Oil Test Pad shows that your oil is dirty.



SPARK PLUGS—Dirty or worn plugs waste as much gas as one coupon in ten. They also cause hard starting which weakens your battery. Under present slow driving conditions, have your plugs cleaned and adjusted every few months.



AIR CLEANERS—A dirty air cleaner increases gasoline consumption because it chokes down the flow of air into the carburetor. Your air cleaner should be rinsed whenever your car is lubricated.



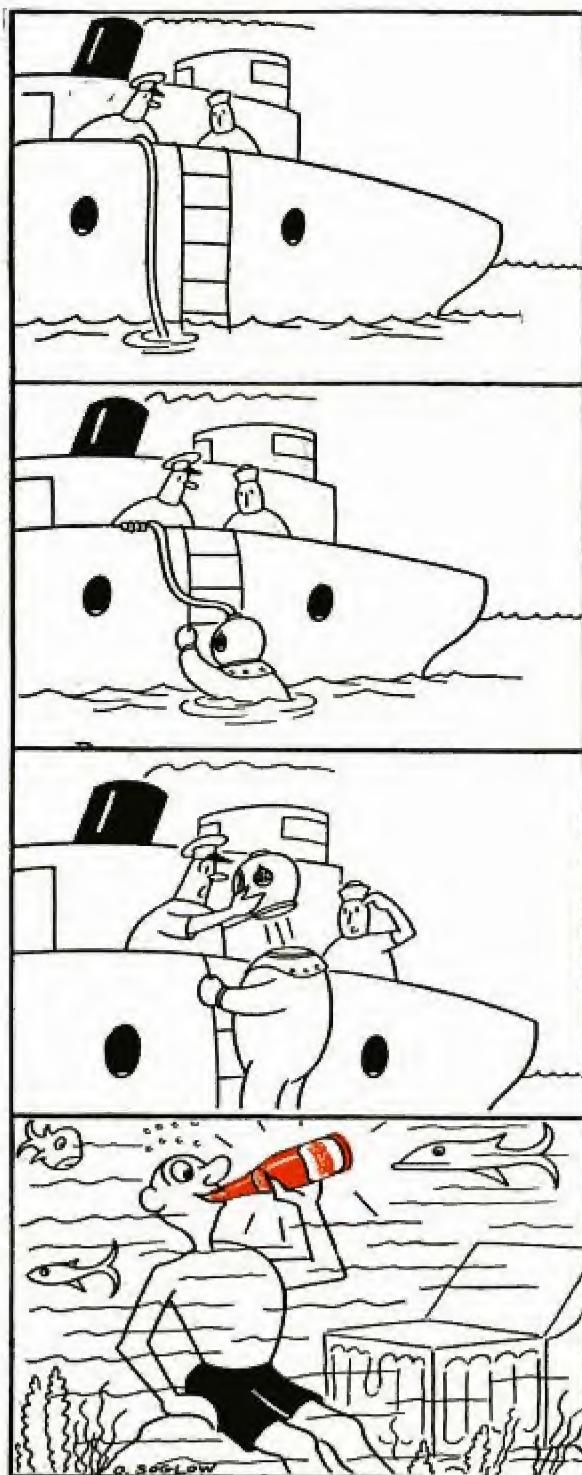
FUEL PUMPS—Practically trouble free. But, if yours has been in use thirty or forty thousand

miles, it may be worn to the point where a check-up is due.



DRIVING INSTRUMENTS—Speedometer, gasoline gauge, oil pressure gauge, ammeter, and temperature gauge seldom need service. But, if they give trouble, have them cared for at once.

BRING VICTORY QUICKER—BUY U. S. WAR SAVINGS STAMPS AND BONDS




... the drink with
QUICK FOOD ENERGY

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IMPORTANT NOTICE

It is the intention of this magazine to provide its readers with information regarding the latest developments in the mechanical arts. We take no responsibility as to whether the disclosures contained in our articles are covered by patents and advise readers to investigate this subject before making, using, or selling any of the products, machines, or processes described in order to avoid possible liability for patent infringement.



WHITE COLLAR or OVERALLS—



Which will YOU wear after the war?

HUNDREDS of thousands of white collar workers have put on war overalls for the duration. Millions of both white collar and overall workers have put on uniforms. Hosts of home women are patriotically taking jobs.

After the war, millions will be coming back from army, navy and air force to civilian jobs; great war materials factories will be re-converting to civilian production; old peace-time functions of business will be springing up—where will you fit in the situation?

If you are wise, you will look ahead and prepare. You will not wait on chance. You will analyze the probable conditions in peace employment, decide where your likes and aptitudes fit best, and get ready. You will decide whether your best opportunities lie in production or office or store. You will determine whether you wish to work for someone else or develop a business of your own. You will train now to be above the average and, therefore, surer to get the opportunity you want after the armistice.

Nor will you wait very long. Nobody knows when this war will end or how soon this problem will hit you in the face.

We Can Help You Decide

If you have some question either about postwar opportunities or about your own fitness for some particular one, probably we can help you. In our 34 years, over one million adults have enrolled for our training, we have built training courses for many

major fields of commerce and industry, and we have gathered a wealth of information about job opportunities and requirements. That information is at your service.

We Can Help You Prepare

And when you have decided what field of work offers most to you for a life career, we can help you prepare for it—quickly, economically, thoroughly, in your spare time and without any interference with your present work—if it is in the list below. A 48-page booklet on the field of your choice, discussing the field and our training for it, has been prepared to help answer your questions. The coupon below or your letter will bring it to you, without cost or obligation.

Do not delay. Whether the war lasts six months or three years, now is the time to make sure your preparation for postwar success shall not be “too little and too late.”

LaSalle Extension University A Correspondence Institution

DEPT. 764-R

CHICAGO

I want to pick my career for after the war and get ready for it now. Send me your free booklet on the field I have checked below and full information about your training in that field.

- | | |
|---|--|
| <input type="checkbox"/> Foremanship | <input type="checkbox"/> Industrial Management |
| <input type="checkbox"/> Bookkeeping | <input type="checkbox"/> Accounting |
| <input type="checkbox"/> Business Law | <input type="checkbox"/> Law: LL.B. Degree |
| <input type="checkbox"/> Executive Management | <input type="checkbox"/> Traffic Management |
| <input type="checkbox"/> Salesmanship | <input type="checkbox"/> Business Correspondence |
| <input type="checkbox"/> Business English | <input type="checkbox"/> Stenotypy |

Name.....Age.....

Present Job.....

Address.....

TAKE MY ADVICE—

*Look
to the
Sky*

FOR YOUR
FUTURE!



WE Air Force officers foresee a great future in the sky. Prepare today for your place in this future . . . when you'll fly your own plane or make aviation your vocation.

Take aviation subjects at night school, study aeronautics at home. When peacetime comes see your Piper Dealer and learn to fly. He can teach you with as little as 8 hours of dual instruction in a Piper Cub.

**Send Today for Your
"HOW TO FLY" Booklet!**

Prepared by a certificated flight instructor. Clearly explains basic flight principles. Send 10c for booklet and Piper catalog to cover postage-handling. Piper Aircraft Corporation, Dept. PM 73, Lock Haven, Penna.




PIPER *Cub*

POINTS THE WAY TO WINGS FOR ALL AMERICANS

Say you saw it in Popular Mechanics!


PROTECT YOUR
Extinguisher
SO IT CAN
Protect You



Priority regulations prevent many civilian customers from purchasing new fire extinguishers. Army, Navy, war production plants and others classed as essential to the war effort must come first. Prolong the life of your extinguisher by keeping it filled and in first-class operating condition.

Your local Fyr-Fyter distributor will be glad to call and inspect your equipment. If there is no distributor in your locality, copy name, size and type of your extinguisher from the nameplate. We will gladly send complete service information.

THE FYR-FYTER COMPANY
Dept. 90 Dayton, Ohio



FYR-FYTER

NEWS

**Increased production
means**



More Jobs for MACHINISTS and bigger pay for men who know their work

This big home-study and reference course gives you the practical facts on machines and methods you need to advance in machine shop work. Take advantage of the other man's experience as found in books, to solve your problems, increase your efficiency, with

The AMERICAN MACHINISTS' LIBRARY

6 volumes—2368 pages—2516 illustrations
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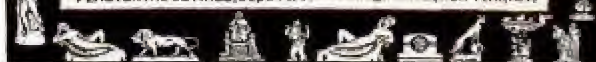
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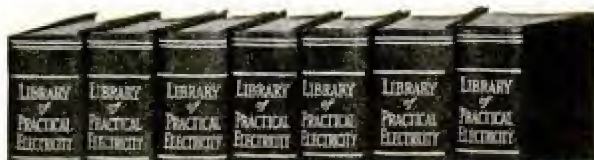
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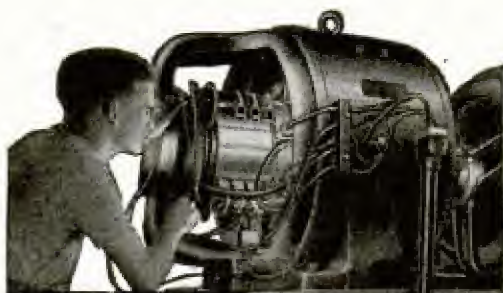
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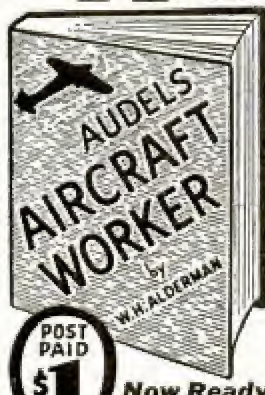
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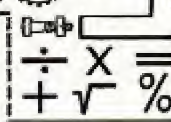
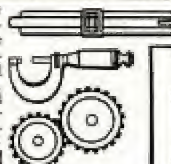
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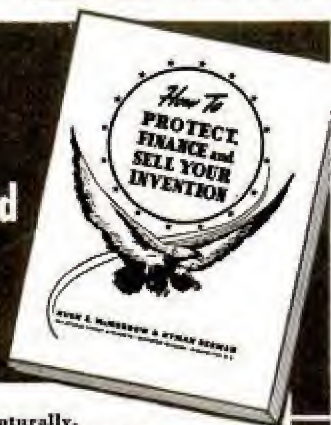
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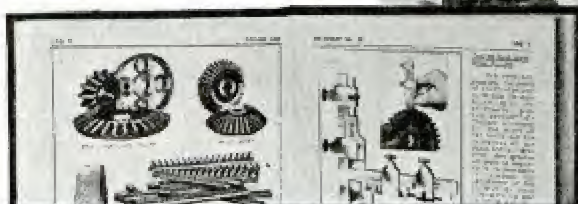
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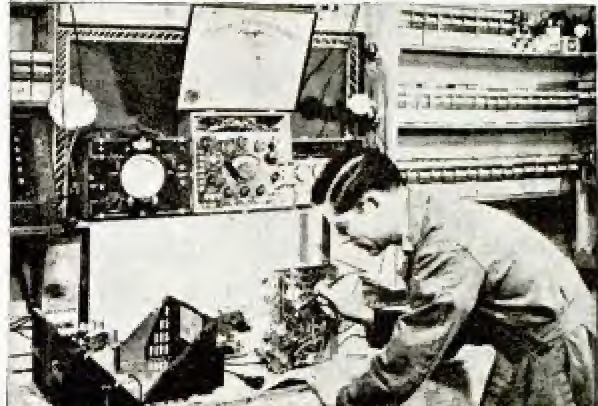
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Vol. 80

JULY, 1943

N 249 No. 1

Mr. Wayne Whetstone



Photo at right by Torkel Kerling
Masked "soldier" of production front welds parts for patrol boat. Right, pressing copper rings in shells

By Wallace N. Barker

Vice-President

Pullman-Standard Car Manufacturing Co.

77 G. Adams, Chicago, Ill.
WHEN America's soldiers on the combat fronts moved from a defensive to an offensive strategy, they reflected activities of her soldiers on the production front who have entered the second phase of their battle to "keep the arms flowing."

Throughout the first year and a half of our war effort industry was busy converting its plants to armament. Many and varied are the stories which tell of how well this task was accomplished and how management turned its plants, almost overnight, to war work. Shortly after Pearl Harbor they entered the second phase—the job of building more effective war weapons and refining techniques to speed production and save strategic materials.



JULY, 1943



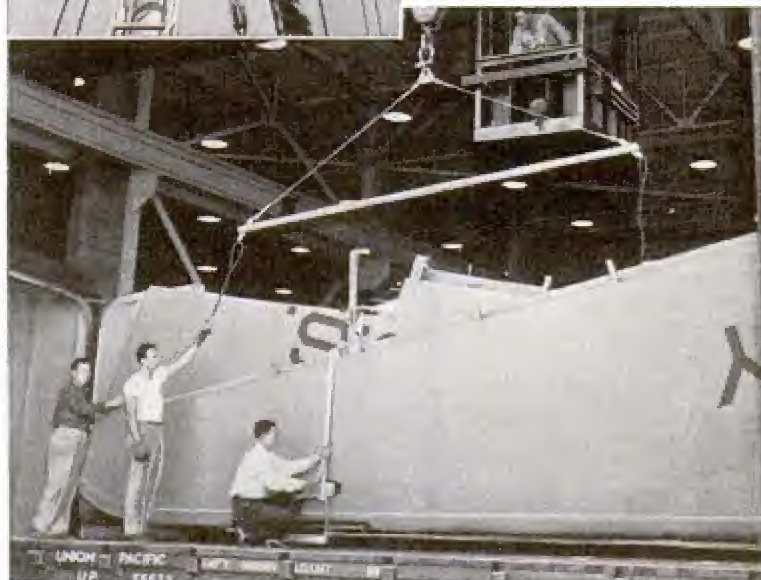
Inspecting trench mortars that helped blast Japs. Right, the crow's nest on Pullman vessel

Slowly and cautiously, lest we help the enemy, the story of this second phase of the battle on the production front is unfolding. Many of industry's greatest contributions to the war effort must remain secrets until victory is won. But others, which can be told, give a hint at what is being accomplished.

For instance, it hardly seems possible that thousands of tons of steel have been saved in the manufacture of large caliber shells without reducing the size or the weight of the finished article. Yet, through improved manufacturing methods, this is exactly what has been accomplished.

Before Pullman-Standard Car Manufacturing Company received its first shell contract from the British government, back in 1940, it had completed an intensive study of shell making techniques. Armament was new to us, but we did have plenty of general "know how" built up

Unloading wings built by Pullman-Standard for cargo planes



from years of experience in supplying the country's railroads with rolling stock.

We introduced to this country a type of roller draw bench being used in Canadian and British munitions factories and had a similar draw bench built to our specifications. We also devised new machining methods, all of which saved metal in shell making.

We noted that six-inch shells, weighing 82 pounds, were being produced from forgings weighing as much as 188 pounds. Our shell line was set up to produce these same projectiles from 142-pound forgings. In another size shell the weight of forgings was reduced from a government specification of 154 pounds to 126 pounds with possibilities of further reductions. In a smaller size shell we reduced the forging weights from 54 pounds to 42 pounds.

Altogether, these refinements in shell forging and machining have saved more than 60,000,000 pounds of steel in our plants alone and passing this information on to other manufacturers en-

abled them to make impressive savings in metal.

In the shell making department we were also able to save on the strategic chemical, trichlorethylene, used to clean shells preparatory to painting. By developing "steam jennies" to do the work equally as well, we have saved more than 30,000 gallons of this chemical, badly needed in other phases of the war effort.



Photos courtesy Pullman-Standard Car Manufacturing Co.
Placing templates (above) into which giant press will force aluminum alloy to form wing braces, ribs



Women war workers putting finishing touches on M-4 tank. Right, wing riveters working on "cat-walks"
Photo at right by Torkel Korling

Adapting to our purposes a sectional method of fabrication, we took on the work of building ocean going naval patrol vessels. Building a ship about a third of a block long was not such a great departure from our normal work. Many of the skills of our car builders were well suited to the type of fabrication we were using on these ships. Skilled car builders needed in shipbuilding include welders, cabinet makers, sheet metal workers, electricians, and others. In addition, a series of schools were set up to teach the few crafts peculiar to shipbuilding. Among these was a supervisors' course that took up the "lingo" of the nautical man so that shop men would

be able to understand navy technicians. It takes as many man-hours to build a patrol vessel as it once took to build a 14-car streamlined train.

We were able to apply to shipbuilding a technique of welding which was developed while building the lightweight passenger car. This technique greatly lessens distortion, a "bugaboo" of all large welded structures. Distortion, if not compensated, can twist a large vessel





Spray painting metal for plane wings in huge booth

out of shape and may cause its plates to buckle and even burst.

Another of our plants has been turned to the work of building wings, tail assemblies and other parts for Douglas cargo planes. With experience gained in the building of lightweight passenger cars for the railroads, we possessed knowledge in the fabrication of aluminum which was second only to that of the aircraft industry.

Calling upon our 30 years experience in devising training programs to supply workers to our various plants, we organized a similar program in the aircraft division. Workers are being trained at the rate of 500 per month. Most of these trainees are soldiers' wives and others from nonessential jobs. This program incorporates many of the features of our previous programs, including utilization of the public and vocational schools.

So well is this training program working, that we anticipate no shortage of labor in spite of the fact that we are expanding the

aircraft division to supply 14 times the production called for in original orders.

Throughout our entire activity of adapting plants to war work, we were able to make use of much of our existing equipment. In the aircraft division we adapted a large hydraulic freight press, formerly used in handling heavy sheet metal, to the delicate work of shaping aluminum alloy. Conversion of this press eliminated the necessity of a long wait for a new press, allowing us to get into aircraft production earlier and also releasing the new equipment that would have been necessary, to some other manufacturer.

In our tank arsenal, near Chicago, we were able to turn to distinct advantage in armament work all of the things we had learned about welding in our prewar days. Developing the prewar all-welded lightweight freight car demonstrated to us many advantages of strength and endurance of welded parts. Before the U. S. entered the war we were cooperating with the army in conducting tests of welded armor plate. Pullman-Standard samples were successful in going through the firing tests at the Aberdeen proving grounds, thus helping to pave the way for the all-welded M-4 tank, recognized as the best medium tank in the field today.

The change from a riveted to a welded tank meant calling upon all previous experience to devise methods of speedy, effective welding. By designing giant positioners, which grasp the hull of a 30-ton tank and turn it end-for-end and upside down, we have made possible the maximum use of down-hand welding, provided the maximum and most efficient use of au-



Trolley coaches are lifted like toys by giant cranes in plant

tomatic welding and, where hand welding is required, insured a weld of superior quality. These positioners require far less skill of the hand welders than operations of vertical or overhead welding.

In another instance, seam joints in these tank hulls were improved so less weld metal was required. This saved more than 150,000 pounds of stainless steel rod used in welding armor plate.

We found that bronze cast connections on the fuel tanks of these juggernauts could be replaced with less critical material. This saved 312,500 pounds of bronze. We also have saved more than 200,000 gallons of lubricating oil by perfecting a filter to rejuvenate and clean the oil after it had been used in M-4 tanks during testing.

In the manufacture of howitzer carriages in this same arsenal, improvements in processing have enabled us to increase our output more than 400 percent since our first orders, and to save considerable steel at the same time.

The most outstanding example is in redesigning the cradle of the piece, which, under original specifications, was machined from a solid rectangular steel bar. By having a 100-pound railroad rail rolled from the proper analysis steel and welded to form the cradle, we reduced the processing time from more than 20 to less than 3 man-hours per unit and reduced the amount of steel needed by one half.

Another difficult problem, which was slowing production and resulting in too many rejects, was solved by the development of a new type machine, which we call a "boromatic." At one setting this machine does the boring, reaming and machining on the cradle which formerly was done by three machines. Heavy rejects occurred under the old system due to moving the cradle from one machine to another, causing it to bend microscopically, but enough to violate the fine tolerances required. The new development reduced the processing time from more than seven to less than four man-hours.

Starting out with a policy of subcontracting from the start, we have so far placed 6,500 contracts with 1,061 subcontractors, of whom about three-fourths are in the small business classification. We extended to these firms the benefits of our organizational experience, and our technical men helped them with production problems on jobs which they would otherwise have hesitated to accept. In many instances we even supplied them with jigs, tools and fixtures specially designed for their plants. We have subcontractors in 227 cities, covering 26 states and ranging from one-man concerns to the largest.

(Continued to page 158)

JULY, 1943

Filter Canister on Gas Mask Arrests Poison Fumes



One way cans go to war—to make gas masks.

Among the reasons cans are missing from household shelves—in addition to the need to conserve tin—is the fact that cans themselves have gone to war. Gas mask canisters are being manufactured by the millions. They contain a chemical filter that arrests poison fumes and passes only uncontaminated air. Life rafts are equipped with cans of chemical powder which, when dumped onto the water, spreads out into a yellow-green signal, visible to airplane search parties. Cans also carry food, medicine, ammunition and other war material.

Scorned Wood-Pulp Byproduct Finds a Promising Future

Lignin, called the Cinderella of the wood-pulp industry because it was not a good mixer, is a dark, chemically stubborn part of the wood that is left after cellulose has been extracted. But Dr. H. F. Lewis of the Institute of Paper Chemistry has found that by combining lignin with organic acids, compounds known as esters may be formed. The resulting compounds have a wide range of properties. Some are hard solids, others firm waxes. One, a waxy ester, is already being used to keep wood plastics from sticking in the hot molds. Other commercial applications for lignin are suggested in the field of plastics, and in the mixing of paints and printers' inks.

By Dr. H. F. Lewis, Institute of Paper Chemistry, American Chemical Society, Detroit, Michigan

Four-Minute Infrared Exposure Dries Warpaint

For protection against weathering, American tanks being prepared for shipment overseas are given a coating of paint. Ordinarily the paint would not dry for 24 hours, but by use of a light tunnel, whose sides and top are studded with batteries of infrared lamps, the painted tank is dried in four minutes. The driver of the tank does not leave his seat, so rapid is the process.



Drying time for a tank's paint is only four minutes, in glowing tunnel of infrared light bulbs

Amphibian Jeep Crosses Water Under Its Own Power

Called the army's most flexible war machine, the new amphibian jeep is capable of operation as a boat or on land. The quarter-ton, four-wheel-drive vehicle is built by Ford, and has a carrying capacity of five men. Confronted with a stream or other body of water, it simply plunges in and without further conversion propels itself across.



Amphibian jeep need not be ferried across water; it just plunges in, and propels itself as a boat

Four Explosives Are Required to Propel and Set Off a Modern Shell

Each round of ammunition fired from a big gun requires four separate explosives; aerial bombs require three. Firing a cannon requires, first, guncotton to propel the shell, which is not used of course in a bomb merely dropped from a plane. But both shells and bombs may use the other three. The most sensitive is like fulminate; it explodes when the shell or bomb strikes. If the fuse is set safe, this is all that happens. If the fuse is "armed," the explosion

sets off a second, more powerful but less sensitive, called a "booster." Tetryl is a typical booster. Finally, the explosion of the booster explodes the main charge, such as TNT. Cyclonite, a new explosive for bombs and shells, explodes even faster than TNT, according to Dr. Alberto F. Thompson of Boston. Such a material exerts the maximum destructive effect, though its power is somewhat less than that of dynamite.

General Electric Co.
Schenectady, N.Y.

Dr. Alberto F. Thompson
Poplar Mechanics
East prof. chem. at M.I.T.
Boston, Massachusetts

71-185

Russ Speaker on Skis Sends News to the Nazis



Red Army troops make widespread use of counter-propaganda to inform the Nazi opponents of the truth about German defeats. Here a unit advances over snowy terrain with a speaker to broadcast news into enemy lines

Nazi censorship does not prevent the Red Army from informing the enemy, even in the front lines, about the progress of Russian offensives. On the snowy northern front, Russian soldiers mounted a loud speaker on runners, so that it could be slid

into a position from which a "verbal attack" could be launched at the Nazis, in the form of a detailed report about Russian victories. Such broadcasts across battle lines often prove the falsity of propaganda the enemy spreads among his own troops.

71-372

Radar Spots Enemy Ship and Plane in Fog or Darkness

One night in the Solomon Islands area an American battleship detected an enemy vessel cruising some 15 miles away. The big guns swung around, uptilted and flung one salvo at the unseen target beyond the horizon. The Jap ship went down. Probably its crew never knew what hit them.

The superhuman detector that spotted the Jap in the dead of night, then found the exact range for the guns, is the same radio-location device that sensed the Japanese bombing planes 135 miles away, headed for Pearl Harbor. Its name is Radar, until recently a War and Navy Department secret. The term means "radio-detecting and ranging." In Britain they call it the radio locator, and credit it with helping to save England during the aerial blitz of 1940-41 by detecting German bombers long before they reached the target and permitting R.A.F. fighters and ground defenses to prepare a reception.

Effective in fog, storm and darkness as in clear daylight, Radar makes it possible to focus antiaircraft guns on Axis planes before they appear through cloud cover. It "sees" with the speed of light. The Radar electron tube sends ultra-high frequency waves out to scan the sea and air. When they strike a solid object they rebound to the transmitting point. Since the waves travel constantly at 186,000 miles per second, the operator can determine quickly

the distance to the target from the time elapsed in the beam's round trip from transmitter to target to receiver. The principle is the same as that of the absolute altimeter, used on some aircraft to indicate the exact distance to the earth, regardless of sea level.

Radar is used aboard American warplanes, warships and at coastal spotting stations. It was a factor in the great American victory at the Battle of Midway. It can spot enemy vessels beyond the rim of the earth's curved surface.

American scientists observed in 1922 that reception from a radio station was interfered with by an object crossing the path of the signals. Not until 1925 was it discovered that radio waves of high frequency would rebound from a target surface. In 1930 research engineers succeeded in picking up signals reflected from airplanes overhead. In 1934 a method of measuring the distance between Radar transmitter and target was devised.

It is no longer a secret that Radar played a vital part in stemming the tide of Axis conquest and starting the tide of victory for the United Nations.

Aviators saved several thousand acres of Florida vegetables from freezing by flying back and forth over the fields to keep the air in motion.

War Dept., Bureau of Traffic Relations, Washington, D.C.

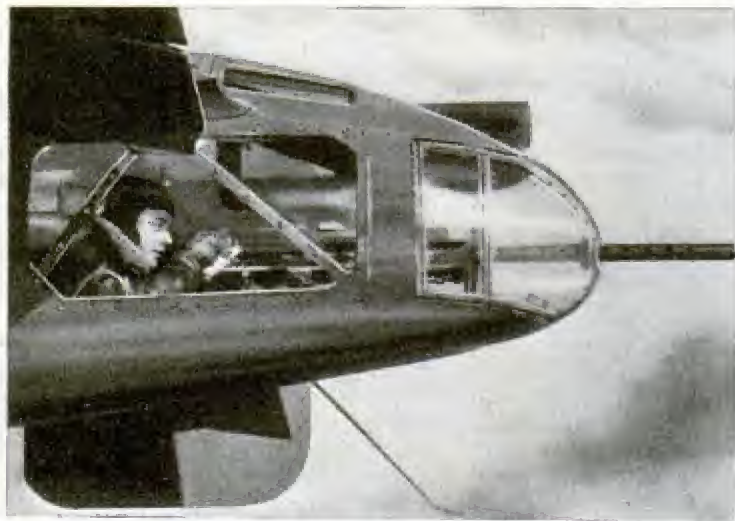
Mr. G. M. Smith

MOLDING *the* WORLD of TOMORROW

Mr. Grant



Airplane windows are made of a transparent, shatterproof plastic. Some day homes will have plastic panes that admit ultraviolet light



By Roderick M. Grant

THIS story will be out of date tomorrow. For nothing is so new as plastics. Count that day lost when no member of the prolific plastics family discovers a new job.

They got their start in billiard balls and false teeth, back in the 'seventies when a shortage of ivory from African elephants first menaced the American pool hall. They acquired a small boy's importance when Dr. Leo Baekeland concocted the phenolic compounds in 1907. They bloomed into the glamor boy of industry in the distressing 'thirties, the era of pink plastic radio cabinets and glorified ash trays and translucent steering wheels. And now the glamor boy has gone to war.

Man really began to mold the world to his own design when he invented the plastics. Until he conceived them, he used the building blocks of nature: wood, stone, clay.

But the plastics do not occur in nature. They are man's own invention.

Plastics are the synthetic materials that can be molded into permanent shapes. Clay is a plastic, but not a synthetic.

They are a prolific and versatile clan. They can be cooked to please any taste. They may be flexible or rigid, drab or colorful; they may have nearly the tensile strength of steel; they may have half the weight of aluminum; they may be explosive or non-inflammable. Poor conductors, they insulate against electricity and heat. Plastic window panes filter out the sun's heat while admitting the healthful ultraviolet rays. There are thousands of plastics with uses ranging above 100,000, and the only common denominators of them all are their name and their synthetic origin.

This war which has taken

Left, the gunner in the Plexiglas tail of a North American B-25. Below, a RKO property man beset by scarcities made this transparent plastic bridle for a movie scene



POPULAR MECHANICS

off the market some of the plastic baubles to which you had become accustomed has also laid the foundation for a plastic postwar world in which you may be clothed from head to foot in plastics, live in a plastic house, drive a car of plastics, fly in a molded airplane. There are planes today which have more than 200 plastic parts; the molded aircraft, however, is not strictly plastic. It is only a close relative. Its molded plywood fuselage was bonded with a synthetic resin, and probably doped or painted with a synthetic coating.

Right now, the whole plastics family is in up to its neck. The moment war struck, the plastics enlisted faster than you could say methyl methacrylate. The soldier's tin hat acquired a molded lining that helps insulate his head against jungle heat and Jap steel. An army rifle got a new phenol-formaldehyde gunstock. A former manufacturer of artificial limbs started molding parts for



Top, machining a bearing made of Micarta, a Westinghouse laminated plastic, which will carry a million pound load in a steel mill. Micarta is molded under 6,000 lbs. pressure

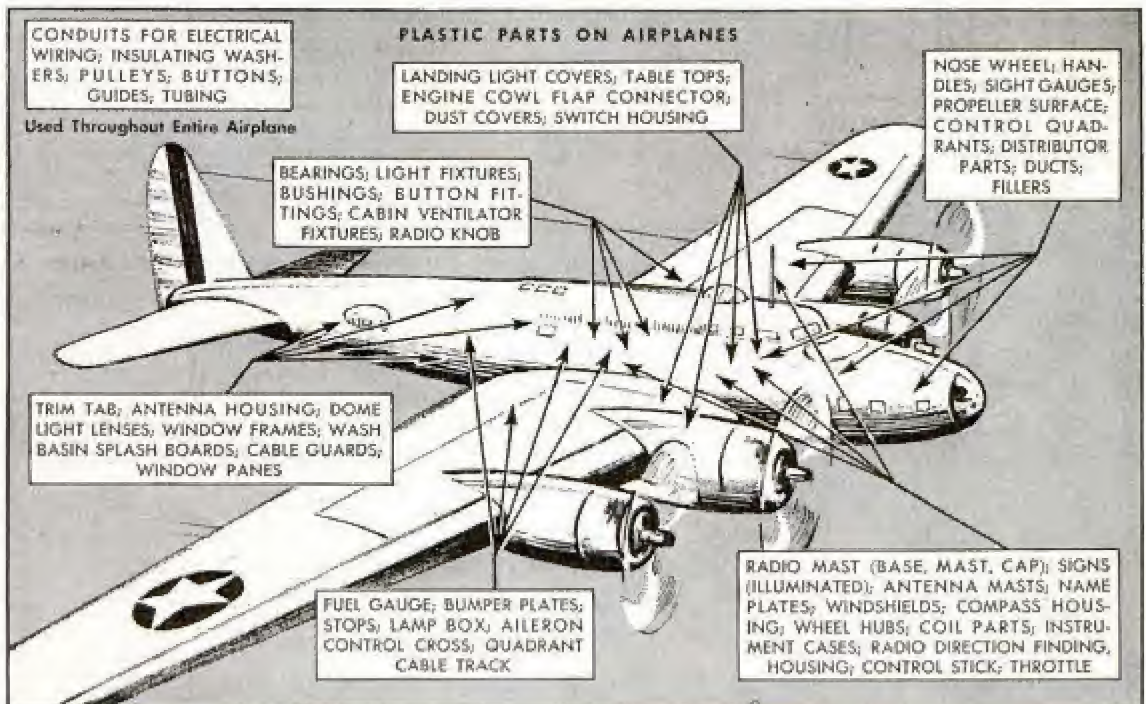


Koroseal tubing made by B. F. Goodrich Company (left) is flexible. Expandable plastic piping like this may solve problems of frozen pipes in postwar homes; transparent tubes are also useful in chemical industry

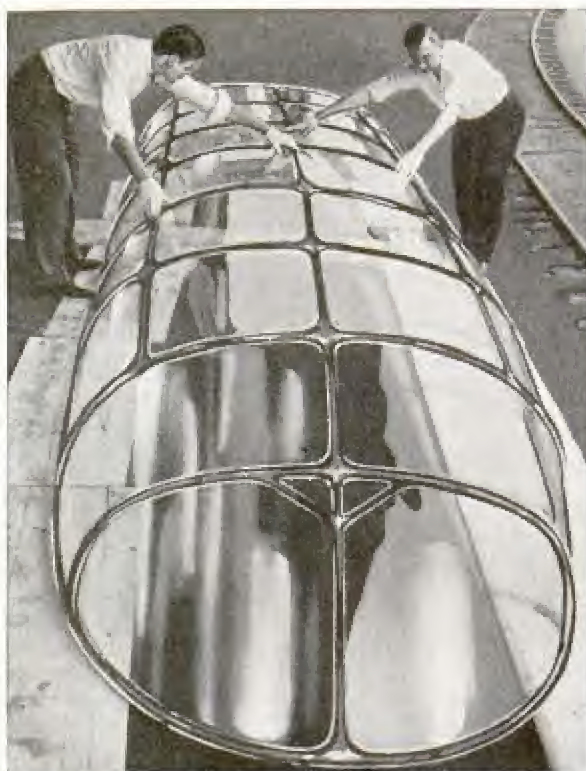
The DuPont chart below gives a suggestion of the multitude of plastic applications in the modern airplane—and the number grows rapidly as plastics replace the metallic parts

Electric - Mfg. Co. C. Pittsburg, Pa.

abene Ohio



Courtesy of C. I. Du Pont



Springfield, Mass.
Monsanto Plastics
One of the largest single pieces of plastics ever made was this transparent canopy for an experimental glider

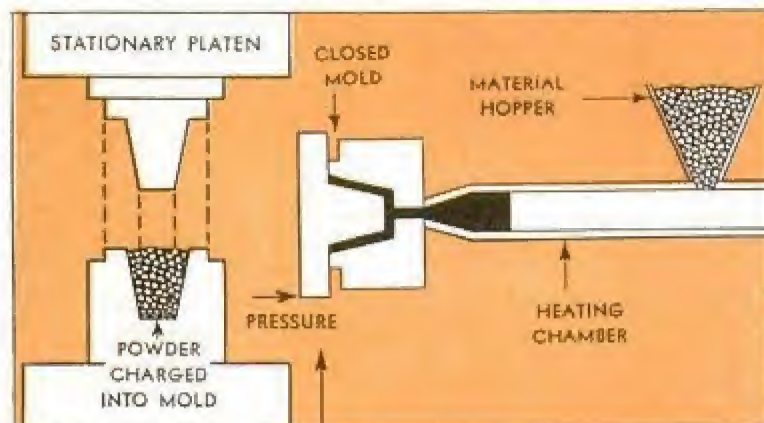


Diagram courtesy Bakelite

a gunsight. Plastic insulation replaced rubber in a war fought by electricity. Yankees on the desert carry six plastic eyeshields for protection against sand and glare; scratched or damaged ones can be discarded for a spare. Every new battleship has more than a thousand plastic parts. The man at the Norden bombsight and the man in the "stinger" of a Flying Fortress look through methyl methacrylate windows that neither shatter nor crack. Mortar shells have plastic fuse caps. Torpedoes wear plastic detonators. Warships have

long-wearing plastic bearings, and shipwrecked men adrift may attract rescuers with a plastic-housed electric light floating beside the life preserver. Even the army bugle has given up its two pounds of brass, and you can almost see as well as hear "taps" flow through the new ten-ounce plastic bugle. You probably won't be up in time to see reveille emerge on its acrylic resin or cellulose acetate note.

The plastic clan comprises a number of families, most important of which are the synthetic resins (alkyds, phenolics, ureas and vinyls); the cellulose family (acetates, nitrates and ethers) and the proteins (casein, soybean, etc.).

They are divided into two types—cold-molded, and those molded under heat and pressure. And the hot-molded plastics may be thermoplastic or thermosetting. Thermoplastics are molded under heat and become rigid when cooled, but have the advantage of being softened for remolding again by reapplication of heat. Thus your thermoplastic dentures can be refitted. The thermosetting plastics, which include the phenolics and ureas, acquire permanent rigidity under heat and cannot be remolded. Being thus impervious to reheating, they can be used where heat resistance is desired. Among the thermoplastics are the cellulose acetates and nitrates and the vinyl resins. There are also various methods of molding: casting, compression and injection molding, extrusion, and others. Rods and tubes, architectural and

reheating, they can be used where heat resistance is desired. Among the thermoplastics are the cellulose acetates and nitrates and the vinyl resins. There are also various methods of molding: casting, compression and injection molding, extrusion, and others. Rods and tubes, architectural and

The diagram shows process of compression (left) and injection molding (right). Below, a plastic violin for Hollywood movie



Ford Motor Company molds plastic cups for latex harvest at Ford rubber plantation

decorative trims and moldings are extruded like toothpaste.

The cellulose family is the oldest. John Wesley Hyatt, an American, was hunting a solution of the ivory shortage in 1870 and produced Celluloid from the marriage of camphor and cellulose nitrate. His Celluloid billiard balls ushered in the era of Celluloid collars and dental plates, pocket calendars and inflammable combs. Within 20 years Celluloid had 25,000 recorded uses, and in the year 1890 it became the basis of continuous photographic film, and thus the father of Hollywood.

The phenolic family is the largest. It was born as "Bakelite" resins 36 years ago, product of the condensation reaction of phenol with formaldehyde. They have done a fabulous business in electrical insulation and telephones and automobile parts.

The proteins are both old and new. Plastics from casein, the protein in milk, have been known since 1870 but comparatively important only since 1923. Small boys of 1925 can remember the skepticism with which they greeted the news that fountain pens were made of milk. Combined with formaldehyde, casein forms a virtually unbreakable plastic used in bombers, buttons and buildings. Casein is also the basis of textile fibers, and your new casein coat may be a cousin of the buttons it wears.

The youngest of the family are the plastics from soybeans and corncocks, coffee and bagasse, the waste of the sugarcane fields. Soybean plastics were dramatized by Henry Ford in his molded car with upholstery of soybean textile fibers and outer panels that resisted the blow of an ax. Scientists at Ames, Ia., ground bagasse into a fine

At right, a 12-pound ball drops 10 feet but fails to break $\frac{1}{8}$ -inch sheet of Lumarith, plastic used for warplane turrets. The four-foot tubes of Dilecto plastic, below, are to insulate electric transformers

Continental-Diamond Fibre Co.



Celanese Celluloid Corp.

powder, chemically treated it and produced an inexpensive molding powder susceptible to a thousand uses. After burning millions of bags of surplus coffee over a decade, Brazil has begun to fabricate plastics of cafelite, a molding powder from coffee beans. Your after-war wall-board and electric light plug and radio cabinet may be made of it. In the same manner many heretofore waste products of



Gas masks are one of the hundreds of wartime plastic products. These are volunteer firemen at a Westinghouse plant. At right, a housewife seals fruit in Koroseal to keep it fresh



Durez Plastics & Chemical Co., Inc., Newark, N. J.

the farm may serve useful and profitable ends. Corn cobs, sugar stalks, straw, oat hulls, sawdust all have promise of a brilliant future in a world of plastics.

You can step into the "bakery" at the Vega Aircraft plant in California and see the chef in tall white hat cooking a batch of "nut bread" for the factory shop. The "dough" is a liquid resin made from ground walnut shells, and it's actually cooked two to eight hours in a standard bakery cookie oven. When it's done, the plastic "nut bread" goes into the tool shop to be used as a drill jig or shaper block or a forming die that will stand four tons pressure per square inch under a hydropress. Forming dies of walnut-shell flour shape Plexiglas noses for bombers; Plexiglas is an acrylic-resin plastic.

12 Rohm & Haas Co.
Washington Square
Philadelphia, Pa.

Wright Aeronautical saves 100,000 pounds of aluminum a month by substituting phenolic plastic engine parts that are molded in one operation, where it took five steps to form the parts of aluminum.

Westinghouse produces a laminated plastic, Micarta, that can form a decorative mantelpiece or the bearings for a sub-chaser's propeller shaft. A 50-pound Micarta roll neck carries a million-pound load in a steel mill, supporting a giant rotating roll.

What started with billiard balls and false teeth has gone a long way afield. This child of the chemical industry is yet in its infancy, but it gives promise of prodigious growth when material shortages cease to hem it in. Plastics have seized wartime opportunities to replace tin in toothpaste tubes, to rival paper in transparent packaging, to substitute for rubber in waterproof coats, for leather in soldiers' heels. The government printing office uses plastic halftones instead of copper cuts. Models made of tough transparent plastics let engineers study internal mechanisms in motion, or the flow of gases. Similarly, transparent plastic piping in chemical plants allows continual observation of processes and the flow of fluids. A thermoplastic pipe can be sawed apart and then welded together again in a minute simply by heating the ends to the melting point and thrusting them together.

If we are some day to mold a bright new world, plastics will play a major part in it. Gustav Egloff, petroleum

Laminated skis are molded for the army "paraskis" by Durez Plastics



scientist, says plastics have made this era "the renaissance of color." He sees ahead an architectural period in which we shall turn away from the drabness of gray cement, natural stone, red and yellow bricks and adopt plastic building materials in colors as beautiful and more practical than the precious stones whose colors they imitate.

The plastics industry that has grown like a young giant under the stimulus of war does not expect to diminish its capacity after the war. Instead, it will fight for a vaster peacetime market. Kitchens and bathrooms may be finished in lustrous plastics that will need no upkeep, for color is inherent in them. Awnings may be of rotproof synthetic textiles. Draperies may be colorfast and fireproof synthetics. Plastic window panes and screens that let in ultraviolet rays and resist breakage better than automotive safety glass are already available. Flexible plastic water pipes will expand but not break when the water inside freezes. Vinyl resin plastics will replace rubber in many uses, and perhaps we shall wear waterproof plastic clothes and dispense with umbrellas. The stuff they use to insulate battleship cables may one day be used by the housewife to preserve food in transparent bags sealed with a flatiron.

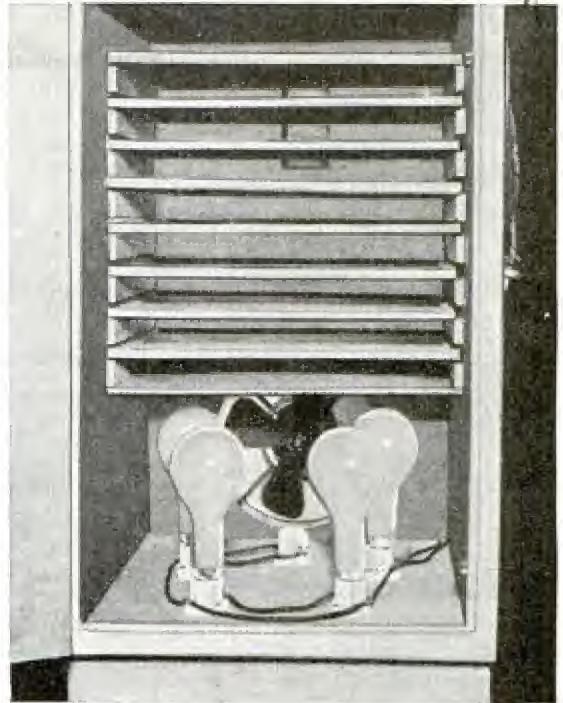
You'll never know where plastics are going to bob up next. You can be fitted with a plastic ear plug, or, to get back to false teeth, your dentist can supply new plastic dentures so tough they'll bite a pencil in two.

Perhaps the strangest plastic operation happened to a duck. The mallard had a bit of a broil with a snapping turtle and came off without the upper half of its bill. A dentist came to the rescue, took appropriate measurements, and the duck regained its dignity with a new pink plastic upper.

Nazis' Six-Motored Transport Carries 130 Men or 11 Tons of Cargo

Latest and largest of Germany's so-called "powered gliders" is the Messerschmitt "Me. 323," a six-engined transport with a multi-wheeled undercarriage for

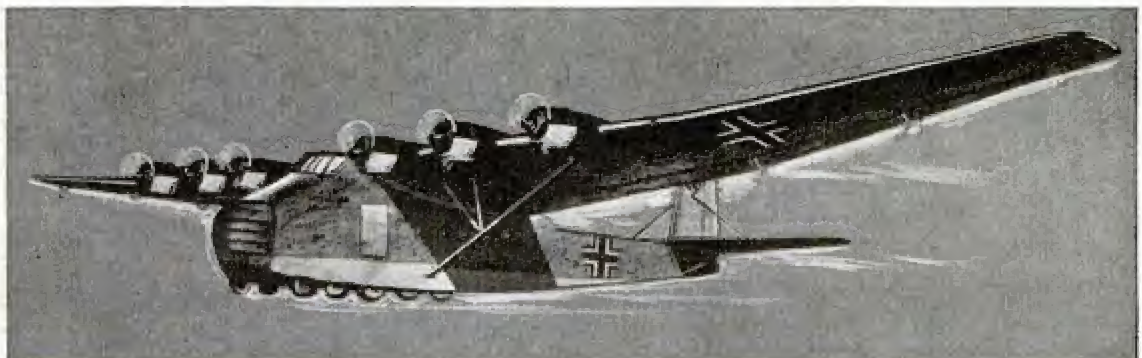
\$10 Home Food Dehydrator Uses Bulbs and Fan



Homemade cabinet houses this dehydrating unit

With the aid of a homemade cabinet, some electric light bulbs and an electric fan, the Victory gardener may also become his own food dehydrating expert. Shelves are provided for the fruits or vegetables, with light bulbs furnishing the heat, and the fan circulating air necessary to preserve foods for months in advance. The entire cabinet can be made for as little as \$10 and operates from an electric light socket, according to University of Tennessee and Tennessee Valley Authority farm experts who designed it.

Memphis, Tenn.



Rep. Mr. Lester Marshall, The N.Y. Times, Times Square, N. Y. N. Y.

ALLIED VERSUS

HEAVY BOMBERS



This is the lineup of heavy bombers for climax of fight

MEDIUM BOMBERS



Medium craft designed for short run with light load

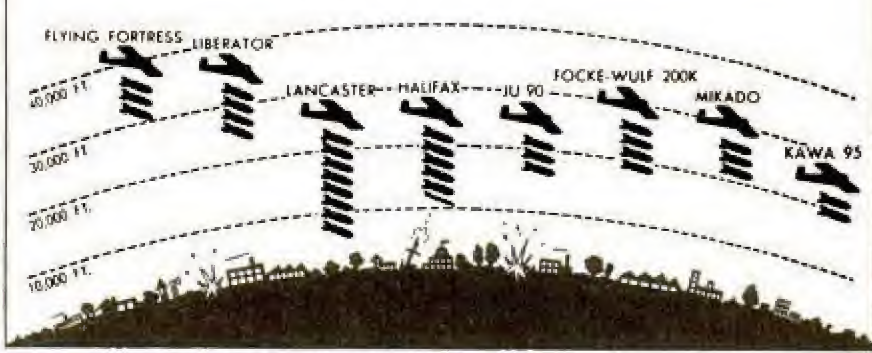
FIGHTERS



Outstanding fighters of war used for escort and pursuit

SERVICE CEILING AND BOMB LOAD

EACH BOMB REPRESENTS ONE TON



Charts by courtesy of The New York Times

American Fortresses and Liberators are designed to fly higher and farther than similar big bombers; the latest model of Fortress will carry a much heavier load

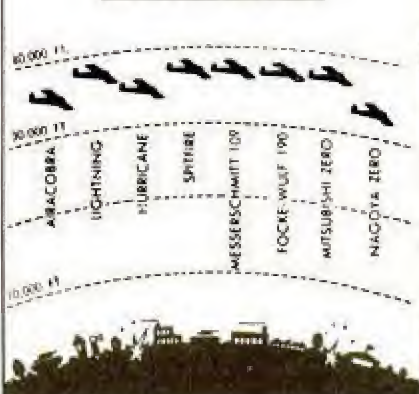
SERVICE CEILING AND BOMB LOAD

EACH BOMB REPRESENTS ONE TON



Leading medium bombers have the same ceiling. The bomb loads shown here are extreme for top speed and range of these planes. The Martin Marauder is the fastest

SERVICE CEILING



ARMAMENT

	CANNON	MACHINE GUNS
AIRACOBRA	1	4
LIGHTNING	1	4
HURRICANE	1	4
SPITFIRE	1	4
MESSERSCHMITT 109	1	4
FOCKE WULF 190	1	4
MITSUBISHI ZERO	1	2
NAGOYA ZERO	1	2

These fighters can reach stratosphere levels far above zone of their best performance. Amount of armament they carry limits speed, range and maneuverability

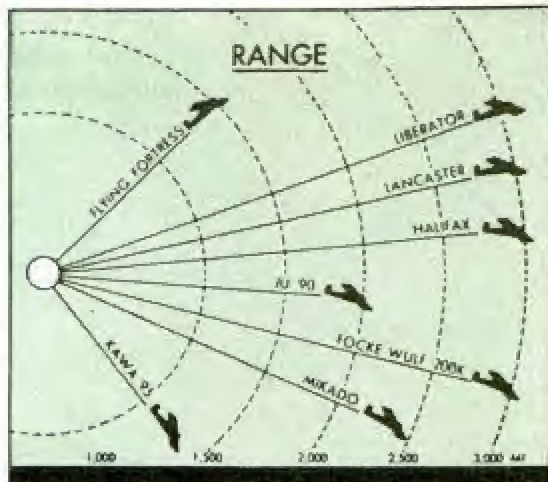
AXIS PLANES

RESULT OF A ONE HOUR RACE



Speed of the heavy bombers is about even, but loads and ranges of these planes will vary at same speed

RANGE



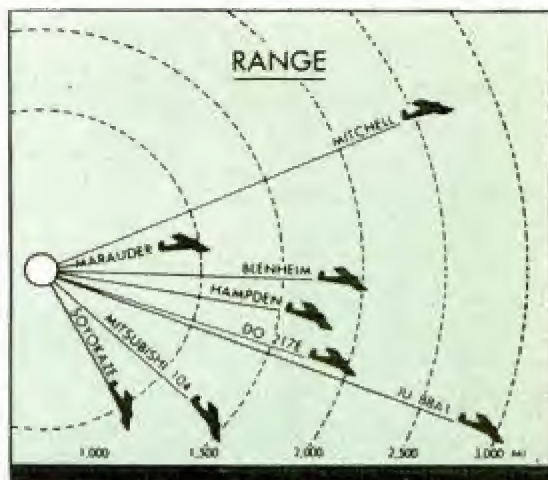
Greater range of Allied bombers is due to pre-war development of this type and more powerful engines

RESULT OF A ONE HOUR RACE



These medium bombers cannot maintain maximum speed shown with full loads on long distance missions

RANGE



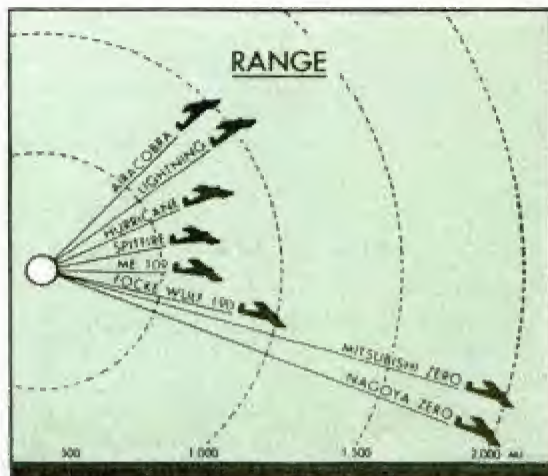
Fast medium bombers like the Marauder have shorter range than planes like the North American Mitchell

RESULT OF A ONE HOUR RACE



Under ideal conditions for each fighter, the speeds are not far apart. Best fighting levels vary greatly

RANGE

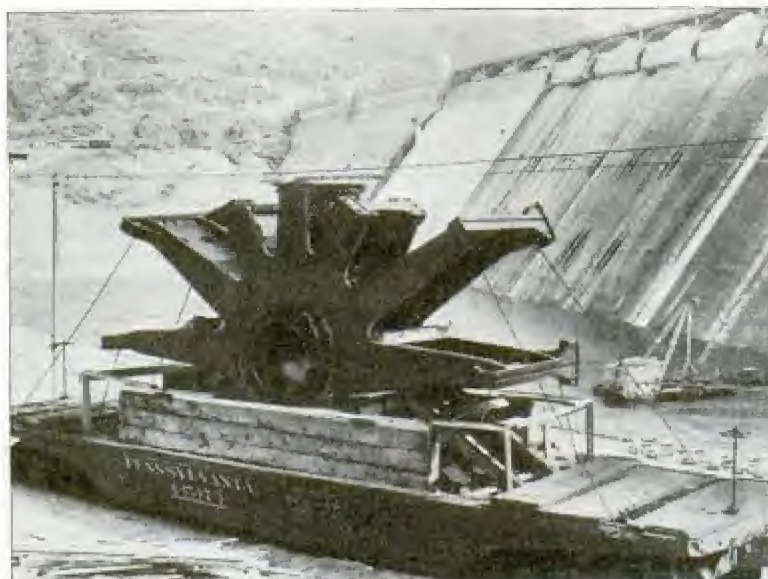


Great range of Jap Zero is due to lack of armament, small firepower; extra fuel tanks also stretch range

Cont: Press Association, Inc., 50 Rockefeller Plaza
N. Y., N. Y.

7-286

Power Plant's "Spider" Rides Underslung Car



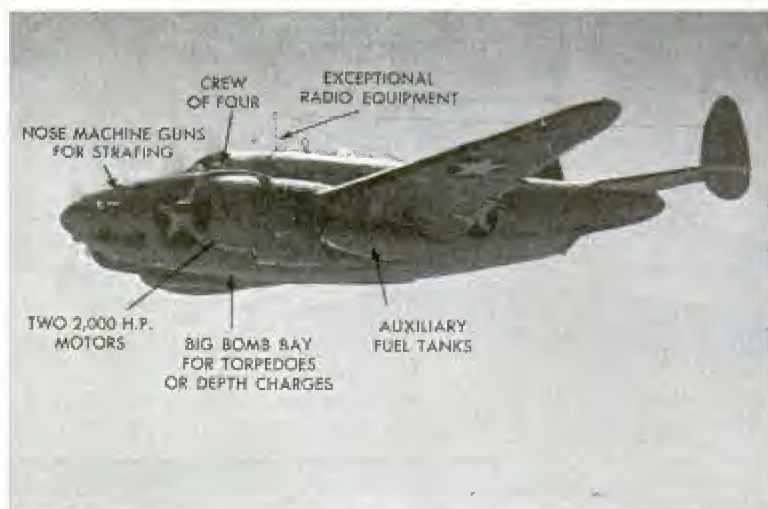
"Spider" is really hub and spokes of rotor for hydroelectric generator

Transporting bulky equipment over rail lines whose tunnels and bridges provide limited clearance frequently tests the ingenuity of railroaders. A "spider," the hub and spokes of the rotor, or revolving unit, for the hydroelectric generator at Grand Coulee dam, had to be carried 3,000 miles from factory to damsite. It was carried in an underslung freight car, with some of the spokes purposely made shorter, to assure clearance during the trip. Extensions were to be added to the short spokes at the point of installation.

7-292

Navy's Winged Sub Chaser Drops "Ash Can" or Torpedo

Nautical version of the bomber the British designate the Ventura is the Navy PV-1, long-ranging, twin-motored patrol plane manufactured by Vega Aircraft Corp. for the United States Navy. Hailed as a promising answer to enemy submarine threats, the big plane carries either "ash can" depth charges or a standard torpedo, and is equipped with droppable fuel tanks beneath the wings, to provide additional range. Though supplied to the Navy for operations against enemy sea craft of all types, the plane is based on land, and as a safety feature it will land under 80 miles an hour. The craft closely resembles the Lockheed Hudson, the plane British fliers affection-



Bristling with guns, heavy with TNT is this nemesis of the Nazi submarine

ately called "Old Boomerang" because of its ability to return, though badly damaged. The PV-1 is powered by two 2,000-horsepower Pratt & Whitney engines.

7-336

High-Speed Saws Burn Metals Apart Without Altering Their Temper

Aluminum and stainless steel sheet, as well as hard steel up to one inch thick, are being friction-cut to form aircraft parts at a Bell Aircraft Corporation plant by use of band saws operated at tremendously high speeds. Hardness of the saw or the metal to be cut is immaterial. Actually, hard steel cuts more easily than soft, as the saw, operating at a speed of 10,000 to 12,000 feet

per minute, generates friction by the sliding action of dull teeth to melt the metal. Friction cutting generates tremendous heat at a very small point, but the heat at the edge of the metal is so slight as to be negligible, and temper of the material is not altered. Operators can hold the metal in the air while cutting, so slight is the resistance of the metal to the speeding saw.

Lockheed & Vega Aircraft Corp.
Burbank, Calif.

cont: M. Allen Harris & Co., 7 Park Ave. N. Y., N. Y.

Ref: Bell Aircraft Corp.
2040 Channahon Ave.
Buffalo, N. Y.

Exercise in Oxygen Mask Balks Pilot's "Bends" 71-259



"De-nitrogenizing," to eliminate the bubbles associated with the bends, is done by exercise in oxygen masks

"De-nitrogenizing" is what high-altitude pilots call the procedure of exercising while breathing pure oxygen, before submitting themselves to high-altitude flights, or similar tests such as Boeing Aircraft conducts in its strato-chamber. Science has found that such altitudes may be borne without

danger of contracting "bends," similar to the dangerous ailment that afflicts tunnel and caisson workers and deep-sea divers, after exercise on an oxygen intake. Purpose of the routine is to remove nitrogen from the tissue, since the bubbles of nitrogen are believed to cause aero-embolism.

Jeep Flies to Battle in Glider and Rolls Out Ready to Fight 71-259

"Silent birdmen" they call the crews of the gliders—the men who will ride the air in unpowered ships to land on enemy soil. And along with the airborne fighters will go the omnipresent jeep, roaring out of the nose of the glider after it lands, carrying half-a-dozen picked shock troops. Mobility behind the enemy's lines is assured by that motoring jack-of-all-trades, the tuckaway transport that carries fighting men with it wherever it goes and can travel on the roughest terrain.



Glider's nose lifts to allow exit of jeep-load of Yanks, set for a scrap

JULY, 1943

Victorville Army Flying School 17
Victorville, Calif.

Art: D. J. Hamilton, 1155 Hermit St. San Diego, Calif.

★ "COMMENCE FIRING"



Flanking the flight deck of a U. S. aircraft carrier, a row of anti-aircraft guns sends a hail of bullets skyward in target practice. Below, lookouts and signalmen in sou'westers keep a vigil for the enemy and use blinker for messages between ships



"LOAD!" shouts the gun captain. The gun crew springs into action. The breech of the 8-inch rifle is jerked open. A 250-pound shell is slipped into the glistening barrel—followed by powder bags. The charge is rammed into place and the breech slammed and locked.

"Ready one!" sings out the gun captain and the report is relayed to the fire-control center. The first shot is about to be fired.

"Stand by!" The men freeze in position and the silence is cut by two sharp buzzer signals.

"Commence firing!"

"WHOOM!"

All the varied and complex jobs performed aboard a man-o'-war have but one goal: to get the ship into position so that the gunners can slug it out with the enemy. For a brief moment in battle, the gunner is king. He speaks with a defiant roar of flame and steel that symbolizes the power of the U. S. Navy.

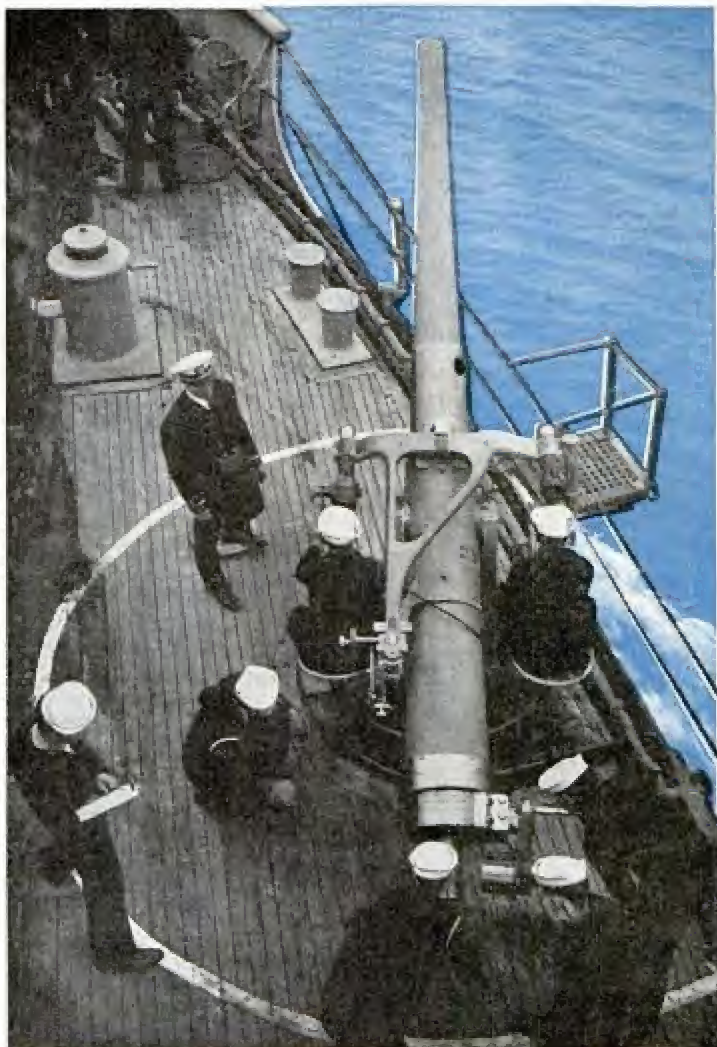
Millions of dollars went up in smoke and millions of man-hours were spent in the toil and sweat of gunnery practice before December 7, 1941. But it gave the U. S. Navy the best gunners

in the world. And now as our bluejackets blast the Japs in the Pacific and the Germans and Italians in the Atlantic, this peacetime investment is beginning to pay dividends.

In the several "battles of the Solomons," for example, which raged around those tropical islands during last fall and winter, American guns and gunnery proved superior to the Japanese. When warship met warship, it was the Stars and Stripes that emerged victorious in almost every encounter.

The weapons of American warships range in size from deep-throated 16-inch battleship guns—which can toss tons of steel and TNT more than 20 miles—to the 30-caliber Browning machine guns of coastal patrol vessels. In between are many sizes—all with a special job to do.

When a gun is fired, tremendous pressures are necessary to give the projectiles the required muzzle velocity. In some of our largest naval guns, this pressure is about 36,000 pounds per square inch.



Above, training a five-inch gun. Below, servicing one of the three-inch dual-purpose guns on a destroyer on coastal convoy duty
U. S. Navy photos





A shell from a 14- or 16-inch gun, for example, emerges from the barrel at the rate of 2,000 miles an hour.

The best brains of American scientists and naval ordnance experts, therefore, have been called upon to develop steels which are strong enough to withstand such bursting pressures. Because of durability and toughness, forged steel, nickel steel and vanadium steel are used in the manufacture of guns for the navy.

The 16-inch gun is at the present time the largest naval gun in use. Our newest battlewagons, such as the giant 45,000-ton battleship Iowa, carry nine of these monster rifles. Each weighs about 125 tons and tosses a shell that weighs around 2,100 pounds. Each shell fired costs the taxpayer more than \$1,200—\$900 for



A giant crane picks up a torpedo bomber like a toy to swing it aboard the deck of an aircraft carrier. Lookouts on the carrier (below) keep watch at many points, scanning the horizon with powerful telescopes and binoculars for ships and planes



the projectile and \$300 for the powder, to say nothing of wear and tear on the gun itself.

Naval guns are of two kinds (1) radial-expanded guns, usually less than 6 inches in diameter, and (2) built-up guns, usually 6 inches or larger.

Radial-expanded guns are built in one piece—expanded by inside pressures. Because of monoblock construction, such guns are of greater strength and less weight than built-up guns. This type of construction can be used only for guns up to 6 inches in diameter, however, because flaws develop in larger guns.

Built-up guns are of different parts, consisting of a liner, a tube and successive hoops fitted as tightly together as the rings of a tree. Building guns in layers allows both inside and outside to be subjected to the same pressure. A single thick tube might be cracked on the inside before the outside felt the pressure. In addition, it is

easier to locate flaws in a thin tube than in a thick one.

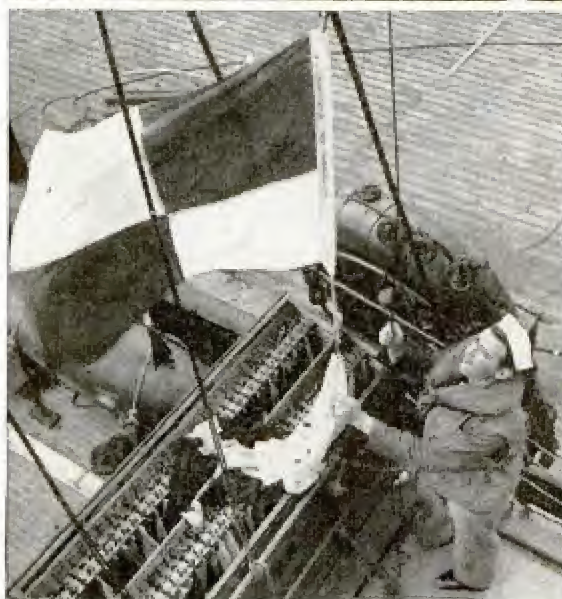
When a gun has taken final shape, spiral grooves are cut on the inside surface of the barrel. These grooves are called riflings and give the shell a twisting motion like a well-thrown football. Thus, greater accuracy is possible than if the shell were tumbling haphazardly through the air.

After a gun has been rifled, it is smoothed off, shaped and inspected—then sent to the proving ground to be proof-fired. The proving consists of firing an overcharge of powder. If it meets with the inspector's approval, the gun is then ready for service on one of the many ships of Uncle Sam's growing fleet.

But building guns is only one chapter



Above, a Navy machine gunner lines up the sights. Below, the crew of a Bofors 40-millimeter twin mount antiaircraft gun stands by for action while in hostile waters. Clips of shells line the armored nest

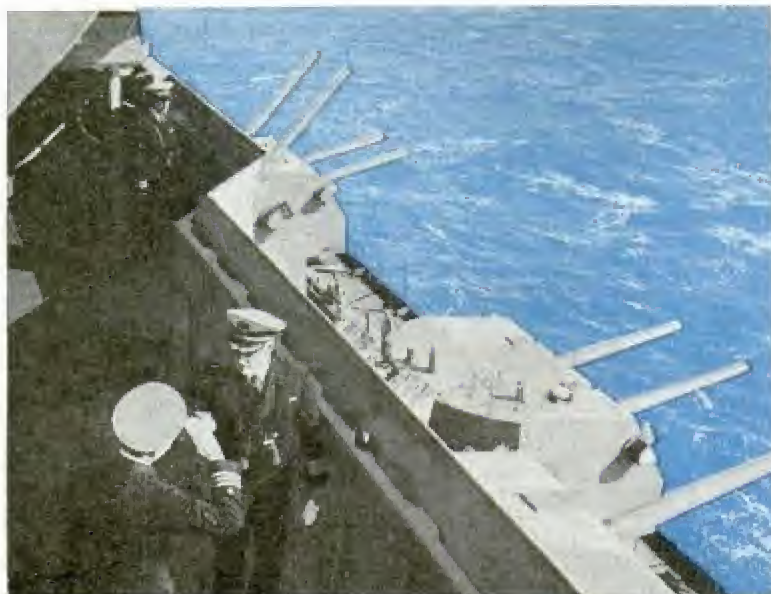


in the story of naval gunnery. Training gun crews is just as essential. And here's where the American love of teamwork is put to use. In its essentials, building a first-rate gun crew is like building a smooth-working football team. Each man has a job to do and a split-second error will throw the whole team off stride.

The gun crew is divided into the "loading crew"—consisting of the gun captain, the plugman, the rammer man, shellmen and powdermen; and the "gun-pointer group"—the pointer, the trainer and the sight-setter. The loading crew might be likened to the linemen of a football team. They clear the way and get things set

Running up a flag signal for intership communication

*Capt. O'Leary M. Nichols, U.S.N. (right)
Comdr. Andrew S. Shepard, U.S.N.*

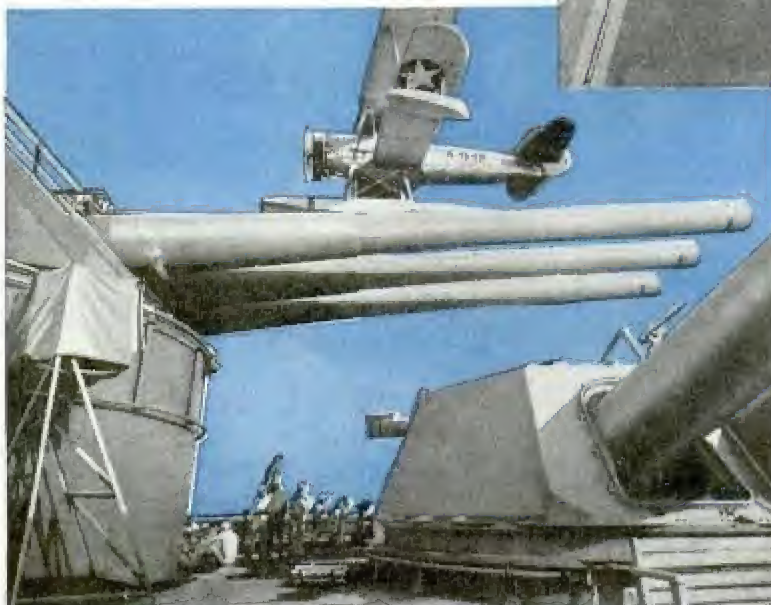


On the navigating bridge of the battleship North Carolina (above) the executive officer reports to the captain: "Ready for firing, sir." At right, the twin forward turrets of one of our big ships

for the gun-pointer group which does the actual aiming and firing.

Not every bluejacket is temperamentally fitted to be a member of the gun crew. For that reason, navy gunner's mates are hand-picked. They must be quick-thinking, skilled in their duties and cool-headed. They are given thorough training, not only in their own jobs but also those of other men in the crew.

Gunnery is a dangerous job. Guns sometimes misfire, causing deaths and injuries. A gun turret is one of the most important targets of the enemy. But for men who have the dash and dar-



ing of John Paul Jones, there's no better job aboard ship. Gunner's mates proudly wear the emblem of their profession—crossed guns on the sleeves of their uniform.

During pre-war days, target practice was held every year by the American fleet. Long range battle practice at 16 miles or more tested the efficiency of the ships for actual warfare, while short range practice at 1,600 yards qualified men as gun pointers and trainers and tested ammunition. Night battle drills, antiaircraft drills, tor-

pedo drills and special drills prepared the blue-jackets for any emergency. Every effort was made to simulate the actual battle conditions in which the men now find themselves.

Cash prizes were awarded the gun crews (including the handling room crews) which made standard scores at short ranges, and to fire-con-

A seaplane rides the catapult beside the loudspeaking guns of the U. S. battleship California

trol, depth charge, torpedo-control and anti-aircraft control groups that showed special merit.

First prize was \$10 per man and second prize was \$5 per man. Winning ships were given the right to paint the highly-coveted navy "E" (for efficiency) on their gun turrets, while members of the winning gun crews wore a white block "E" on their uniforms.

Aboard Uncle Sam's battle-wagons, powder and shells are stored in specially constructed compartments below decks. These rooms are fully protected by armor and are located as far away



Asbestos-clad fire fighters stand ready for action as a Navy plane rolls along the deck of a carrier. Below, a 20-mm. Oerlikon gun, best protection against low-flying aircraft

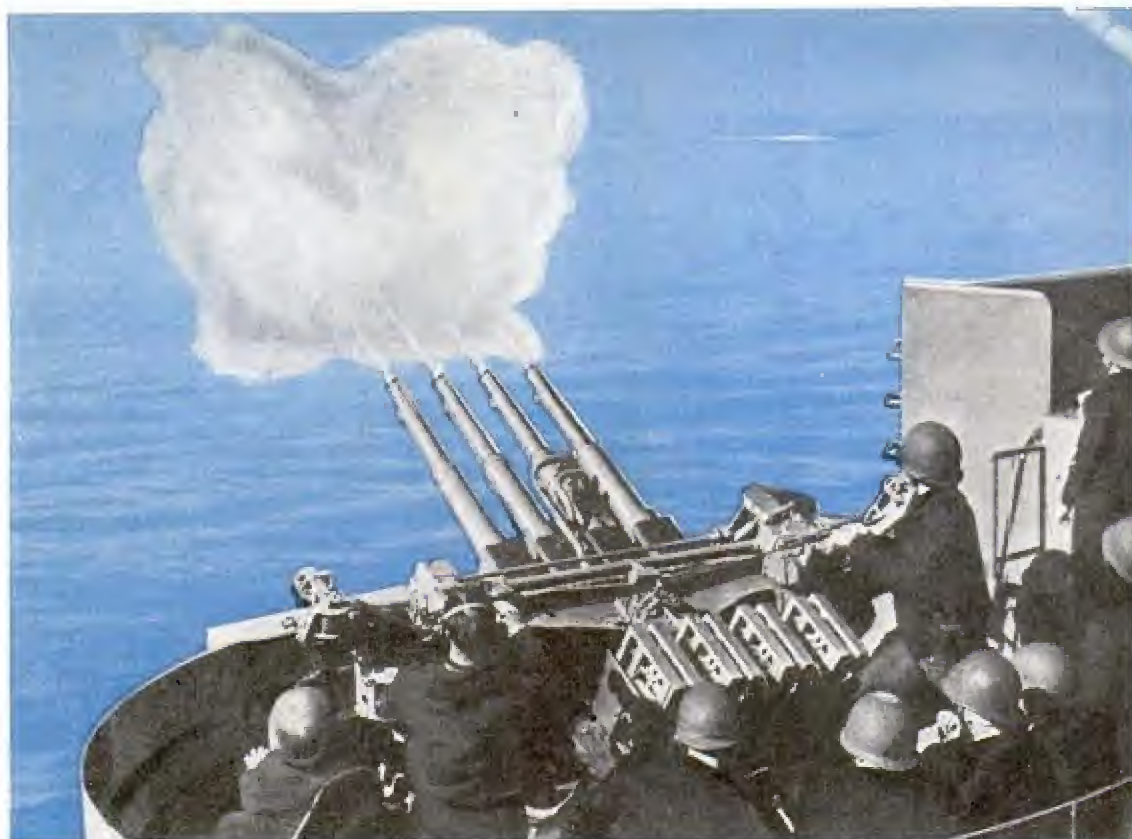


Right, three sailors clean a cruiser's gun

from engines and boilers as possible. Ponderous belt conveyors carry the ammunition to hoists by which it is lifted to the guns above. A number of safety precautions reduce the hazards of handling ammunition, and powder rooms can be flooded quickly with water in case of emergencies.

Ammunition for the big naval guns is generally of two types: case ammunition and bag ammunition. Case ammunition, used in the smaller guns, is all in one piece like the cartridges used in hunting





rifles. Bag ammunition, on the other hand, is used in the larger guns and the projectile and bags of black powder are placed in the barrel separately—somewhat like the ball and powder of old-style flintlock rifles.

Projectiles are of several types, according to how they are used:

(1) Armor-piercing shells are used against heavily armored enemy ships.

These projectiles are a massive piece of metal—containing a cap of specially hardened steel. Only a fraction of the total weight is the bursting charge of TNT.

(2) Common shells are the same as armor-piercing except that the metal is thinner, thus allowing a larger powder charge. These shells are used against enemy ships that are not heavily armored.

(3) **Target-practice** shells are of the same size, weight and shape as common shells, but are made of cheaper materials. Instead of a bursting charge they are filled with sand or other heavy material to bring the shell to the proper weight.

(4) Nonricochet shells are flat-nosed projectiles with a large bursting charge—used principally against submarines. They do not skip across the water like some types of shells, but plunge beneath the surface.

(5) Shrapnel shells are thinly walled and filled



A seaman first class services a small gun on the Indianapolis

with small iron balls. They create a hail of death when they burst over an enemy ship at a height of 50 feet.

(6) Illuminating projectiles are fitted with a time fuse. When the shell is exploded, it releases a small parachute carrying slow-burning powder. It looks for all the world like a 4th of July rocket.

Modern naval guns have great ranges and can be fired extremely rapidly. As a matter of fact, they can be fired farther and more rapidly than they can be accurately controlled. In actual battle, guns of our biggest warships are fired at distances of 16,000 to 32,000 yards, according to the target and the visibility. In proving ground tests, some of our more modern weapons have fired much farther.

The secret of accurate gun-fire is "fire control." This means a system of controlling the fire of the guns—not fighting fire as some civilians think.

It is a complicated system in which range finders, directors, telescopes, rangekeepers and a whole battery of electrical transmitting, repeating and recording instruments are used to put the shell on the target. Fire control is one of the most closely guarded secrets of the U. S. Navy—ranking alongside the Norden bombsight and Radar as the No. 1 "hush hush" subjects of the war.

An enemy fleet—its ships maneuvering, twisting and turning several miles away—

is a most difficult target to hit. But American naval gunners with modern guns and fire control equipment, have already made impressive scores. And they're just itching to get within shooting range of more enemy ships, the bigger the better.



En route to Africa a sailor lines up belts of "calling cards" for the enemy—.50 caliber bullets to be fed into a machine gun

Steel Liferaft Carries 20 Men and Is Propelled by a Sail



Metal sailing liferaft for merchantmen also has steering gear

Lives of hundreds of seamen on torpedoed merchantmen are expected to be saved by use of a steel liferaft, approved by the Coast Guard as suitable equipment for merchant ships sailing into war zones. Designed to carry 20 men, and with greater safety and comfort than other rescue craft, the liferaft boasts a covered cockpit and sailing and steering gear.

Find Rare Metal Rhenium In Steel Mill Flues

Useful amounts of rhenium, a rare, silver-colored metal heavier than gold or lead, have been discovered in the flue dust of steel mills. Isolated in 1925, the new metal, which has secret war uses, resembles tungsten, molybdenum, and manganese. Among all metals, tungsten alone will stand more heat than rhenium before melting. It has electrical uses, and is a catalyst in certain chemical processes.

JULY, 1943

Dr. A. D. Melander
G. H. Bacon
American Chemical Society
U. of Texas

All-Weather Training Plane Uses Skis and Wheels



Wheels or skis may be lowered to land the "Swoose"

Skis that retract several inches when landing wheels can be used are snowy-weather equipment for the "Swoose," nickname of an all-weather combat trainer built by North American Aviation, Inc. Even the tail wheel of the plane is equipped with miniature skis to prevent its digging into the surface in the event of a landing in a snow-covered area. *Dallas, Texas*

Pollen Is "Stolen" From Bees As a Rich Vitamin Source

Calender Pollen gathered by bees has been found to be a rich source of vitamin A, the B-

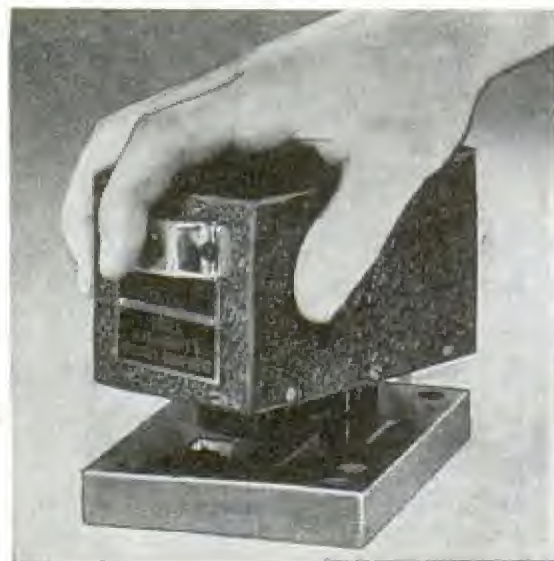


Screen-brushes pollen from bees' legs into reservoir

*Dr. H. A. Scullen
Oregon State College*

complex, and vitamins C and E. Additional research at Oregon State College shows that pollen contains more thiamin than any other food except brewer's yeast. An ingenious trap designed at that college "robs" pollen from bees as they enter the hive. "Bee bread" made within the hive from pollen is absolutely essential to the well-being of young bees, therefore not all of it may be taken. But it has been found that one colony of bees can provide excess pollen sufficient, when mixed with soybean flour, to feed 50 bee colonies. The pollen trap consists of a double layer of hardware cloth which scrapes the pellets from bees' legs as they enter the hive, the pollen falling into a reservoir below. H. A. Scullen, bee specialist at the college, estimates that if all hives were equipped with such traps, bees in Oregon alone could produce a million pounds of pollen as a sideline to their main honey output.

Palm-Sized Tool Demagnetizer Can Be Carried to the Job



Tiny demagnetizer plugs into nearest electric outlet

To demagnetize tools without the necessity of removing them from the scene of work, a portable demagnetizer, small enough to fit the palm of the hand, may be plugged into any 110-volt, 60-cycle circuit, and operated by pressing a finger-control button. The device is drawn over the tools or parts to be demagnetized, and by turning it bottom up it may be used as a bench unit.

¶ You can obtain additional information about products described in this magazine by writing to the firms listed in the Where-to-Buy-It index. Say You Saw It in Popular Mechanics.

POPULAR MECHANICS

*Writing Machinery Co.
2832 E. 1st Street
Grand Rapids, Mich.*

Cont. Major Guilan O. Leggett
2200 Fair Hills Blvd.
Bellevue, Dayton, Ohio

Twin Barges Ferry Tractor Ashore From Ship



Such heavy machinery as tractors and bulldozers, needed immediately to build airfields or prepare the ground for cantonments, are landed directly behind invading troops by landing-barge ferry

Building an airfield or cantonment from scratch is often a rush military job that calls for the use of such heavy machinery as Diesel-powered tractors. But the matter of getting a tractor from ship to shore where no docking or crane facilities are handy might stump the inexperienced. A

method of rushing such machinery ashore right on the heels of invading forces has been worked out by using self-propelled landing boats. The tractor is slung on a platform between two boats, and they ferry it right up onto the sand, from where it can roll ashore and begin its work.

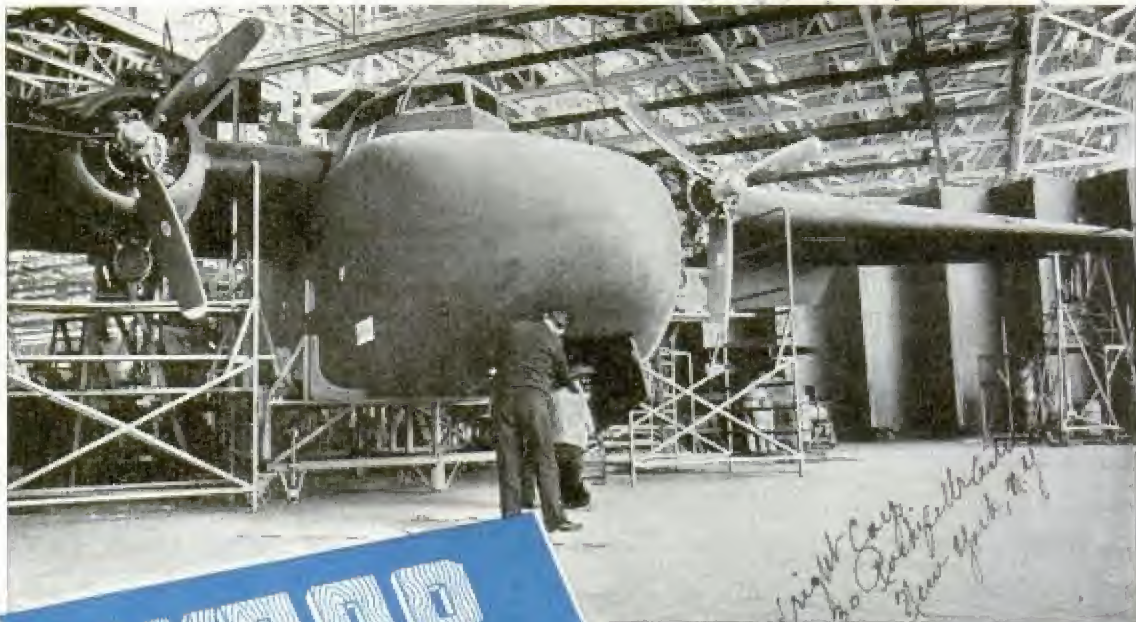
Portable Plane-Control Tower Used at Auxiliary Fields

To direct takeoffs and landings of planes at auxiliary airfields that are not equipped with standard control towers, a portable unit has been put into operation. It is transported from the home base to the auxiliary field in a jeep, and can be placed in service by one man in less than a minute. The complete equipment, plus a service battery and a spare, is mounted on a two-wheel chassis. The unit generates its own

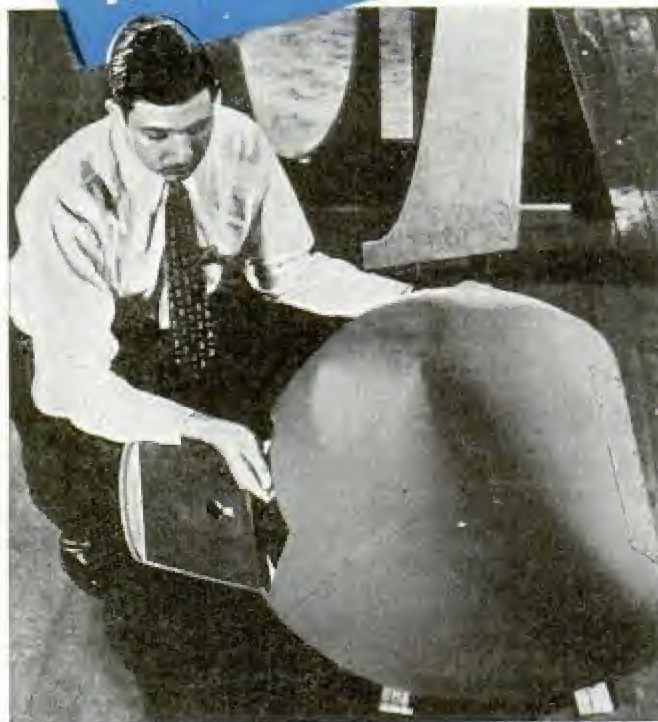
power, thus eliminating any electrical attachments. Before its development, the custom was to use a "control plane," stationed on the ground, to transmit messages to pilots. This often resulted in wearing down the control plane's battery to the point that it would not turn over the propeller, leaving the control plane useless until a new battery could be obtained or the old one recharged.



Carried in a jeep and ready for operation less than a minute after it arrives at an auxiliary field, this portable control tower saves grounding a plane merely to use its radio for messages



WOOD TAKES to the AIR



"TIMBER!" That traditional cry, the woodsman's warning that a tree is about to fall, has new implications for the Axis. It still means: "Look out below!" Only now the hazard is not from falling branches, but from falling bombs.

For wood has taken to the air, with a vengeance and on vengeance bent. Uncle Sam's program of building wooden planes

Curtiss "Caravan," a sky-freighter, above, is one of many new wooden planes. Left, a bomber tail cone, made by Duramolding

and gliders is proceeding at top speed, and for all of Tojo's scoffing this news is bad for the Axis. Goering is one who has already had an embarrassing experience with the United Nations' "flying furniture."

His well-advertised radio speech on the Nazi 10th anniversary came off late because he had visitors—a flight of R.A.F. Mosquito bombers, called by some the fastest in the world. These planes, of "simple wooden construction," as British releases describe them, punctuated the anniversary speech with bombs.

To date, these R.A.F. sensations are the loudest answer to questions about the value of wood as a raw material for making aircraft, but Uncle Sam has a dozen other answers, about which the enemy will hear in due course.

Combat planes, cargo planes, training planes and gliders, as well as multitudes of aircraft parts, are pouring out of not only established aircraft plants but out of furniture factories, woodworking shops, cabinet-makers—a pickle plant is even producing plywood parts.

The assembly lines run across the continent, from forest through mill to subcontractor, to assembly point—and into the air.

"We are finding that to be without wood in time of war would be almost as bad as being without bread," says Miss Margaret



Wooden "Mosquito" bomber, above, is type that has bombed Berlin. Right, troops landing from Waco wooden-wing glider

March-Mount of the United States Forest Service. Wood, in the form of plywoods and plastics, she adds, is "a raw material from which almost anything can be made."

Yankee industries that are literally cooking up fighting planes are proving the truth of this.

Woodworking plants that had but few war contracts are now consuming forest products at such a mammoth rate that concern has been expressed about a shortage of wood—though not because of a lack of trees but because of a shortage of men to cut them.

Woodworking units in automobile factories, which had been idle since the advent of all-metal auto bodies, have been taken "off the shelf," re-equipped, newly manned, and turned loose on the aircraft program. One such plant is building a glider, with a fuselage of



Veneer and glue strips, molded under pressure, form stabilizer surface for a Fairchild trainer



Half of a droppable fuel tank—a Duramold product

tubular steel covered by long-fiber cotton fabric, and with wings of aircraft spruce and mahogany plywood. Others of the new air types now in production contain virtually nothing but wood.

Conspicuous among these is a "flying boxcar," mammoth Curtiss "Caravan," first military transport of this war built almost entirely of wood and other nonstrategic materials.

Versatility is the "Caravan's" middle name. It combines molded plywood, laminates and "plain lumber." Sixty-five percent of its production is subcontracted to the wood industry. Powered with two 1,200-horsepower engines, it has a retractable tricycle-type landing gear for maximum maneuverability on small landing fields. It can carry such heavy cargoes as huge parts of other planes, tractors or field artillery. It carries a cable to which paratroopers' release cords may be attached. It can be equipped with fittings for towing gliders. In brief, it is a big package of bad news for the enemy.

Both the cargo-plane program and the glider program were launched almost as soon as the United States was at-

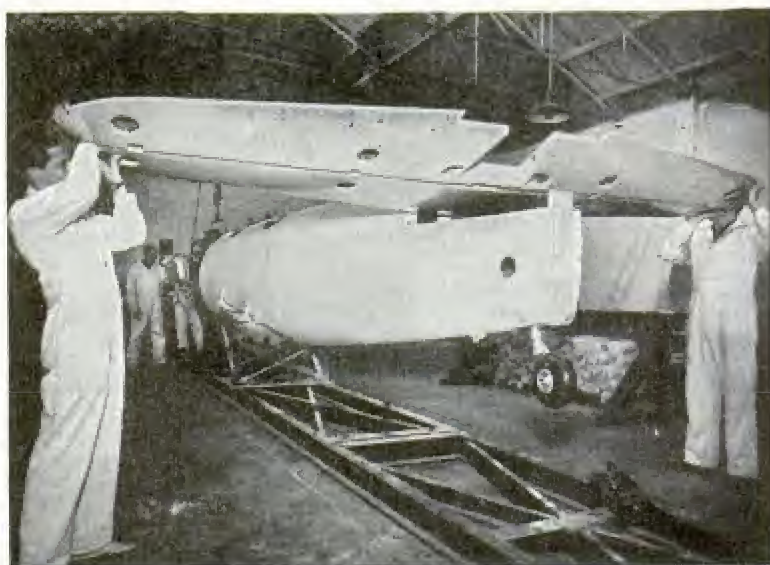
tacked, and were quietly proceeding throughout the period when hearthside tacticians were lamenting that our military wasn't air-minded enough. The lesson of Crete, history's first air-borne invasion, did not go unheeded.

Waco Aircraft Company, for instance, was early given a contract to develop two models of big troop- and cargo-carrying gliders. For volume production, 17 other manufacturers from coast to coast were given contracts to build similar gliders after the Waco designs were approved—small gliders for advanced training, big ones for actual, tactical missions.

Waco's 15-place "CG-4A" glider has a fuselage of steel tubing, fabric covered. Wings are of wood—box spars, spruce ribs and plywood covering. There are no intricate subassemblies. The subcontractors include former furniture manufacturers, piano factories, woodworking and cabinet-making shops. Each builds one section, and the sections are shipped to central points for assembly. Once assembled, they are often simply towed away to their base, and the sight of a transport hauling one or more gliders overhead is fast losing its novelty to some American communities.

Glider, besides costing only a fraction as much as a transport plane, multiply the transport's effectiveness. Like a truck or locomotive, a plane can pull more than it can carry, so the useful load of a transport is multiplied by the number of gliders it can tow. If a glider must be "mushed in" for a landing at an unfavorable spot, its loss is not nearly so serious as would be the loss of a powered plane, and it can land on rough fields where a "hot" plane would stand no chance.

Outstanding among plane designers using wood is Fairchild Engine and Airplane



Attaching tail surfaces to fuselage of Timm Aircraft's trainer, a plastic-plywood Navy plane

Corporation, developers of the process called "Duramold." More than two years before the war began this company was seeking possible substitutes for aluminum—specifically, a substance that could be molded and fastened together with adhesive, thereby eliminating the then high cost of riveting. The new material had to have the same strength/weight ratio as aluminum, and had to be capable of presenting perfect contours and smooth surfaces.

Rough surfaces mean lost power, accounting for the practice of flush-riveting plane skins, and even waxing the flush rivets. Sherman N. Fairchild, chairman of the board of the Fairchild Company, declares that even with these refinements surfaces become wrinkled and rough, with consequent loss of performance.

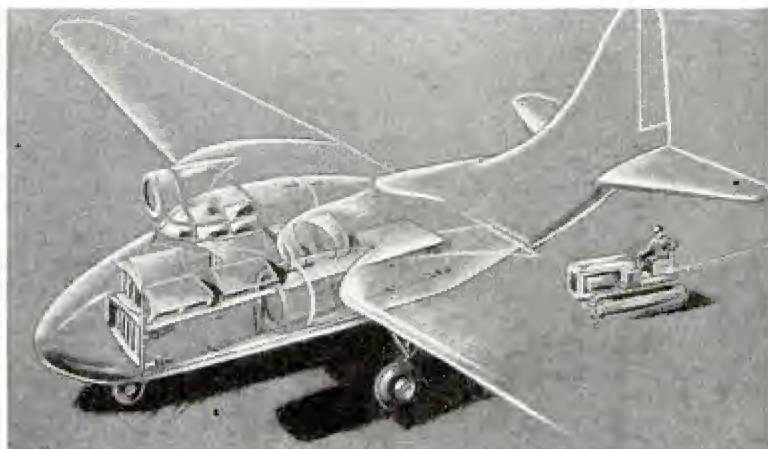
"A Spitfire," he declares, "is said to lose 23 miles an hour just because of the increase in the roughness of the wing surfaces with use. All our investigations led to the use of fibers, preferably wood fibers, in the form of veneers bound together and protected by plastics. It was evident then that the material was nonstrategic, and for this reason might be of great value in time of national emergency."

However, Mr. Fairchild looks upon such raw material not as merely a wartime substitute, but "as a new material with both great structural and aerodynamic advantages."

Fairchild's refinement of "bag molding" assures uniform pressure in the molding process. Latest product of this process is the Fairchild AT-14, officially named the "Yankee



Alternate strips of veneer and adhesive are laid out in dies in the Duramold process, which uses fluid pressure applied through flexible platens in an autoclave, or huge tank—a variety of "bag molding." Workers above lay out strips to form the entire quarter section of training plane



Cutaway drawing of huge Curtiss "Caravan" above shows how bulky cargoes may be carried. Below, first step in plastic-plywood fuselage construction at Timm Aircraft: Spruce veneer strips are cut to shape under steel template, laid lengthwise over wooden form. Fuselage is made in halves





Joining the two halves of fuselage shell of Timm plastic-plywood trainer

Doodle," a twin-tailed gunner crew trainer.

Only metal used in its construction is in the engines, the engine supports, instruments and certain other equipment supports. Main portion of the fuselage is of true monocoque construction, with all stresses being taken in the skin itself, without the use of longerons or lateral stiffeners, except surrounding the openings.

Another manufacturer of plastic-bonded plywood planes, Otto W. Timm, president of Timm Aircraft Corp., which builds the Navy trainer N2T-1, is a firm disciple of the advantage of wood.

Herewith are presented Mr. Timm's views of the place of wood in the manufacture of planes:

Plastic-plywood craft may be easily built and repaired, using existing woodworking plants and their craftsmen, and the unlimited sources of supply.

Plywood is more fire-resistant than mag-

nesium or aluminum, and also corrosion-resistant—of particular value in naval aircraft and in aircraft for tropical assignments.

Plastic-bonded plywood stands up better than metal under gunfire; bullets and metal fragments leave clean holes only the size of the projectile when piercing plastic-plywood, while against metal construction bullets splay, leaving jagged tears.

Gunfire also tends to pull metal plates loose at the rivet joints, while plastic-plywood joinings are not affected in that manner.

Elimination of rivet heads and overlapping edges permits greater speed because of reduced skin friction.

Resilience of plywood makes wooden planes less vulnerable to the rough usage on an airfield in wartime.

Obviously, such a series of contentions leaves the door wide open for a dispute about the comparative values of wood versus metal in the manufacture of planes. But Uncle Sam and his nephews even more obviously stand to profit from the wedding of the metal-aircraft program to the wooden-aircraft program. It's in the American tradition to wade into a scrap with a weapon in each hand.

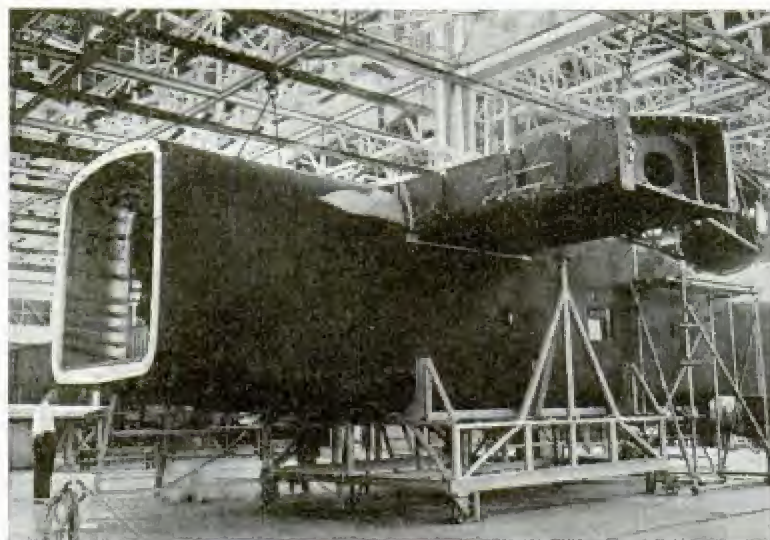
We can all join in the horse-laugh at the expense of Gen. Hideki Tojo, Japanese prime minister and World Public Enemy No. 2, who shed crocodile tears over "weak America" in a recent radio talk in which he made this comment:

"It is virtually impossible for America to keep pace with the huge consumption involved (in waging war). For instance, the United States is now forced to make wooden planes, owing to the dearth of aluminum."

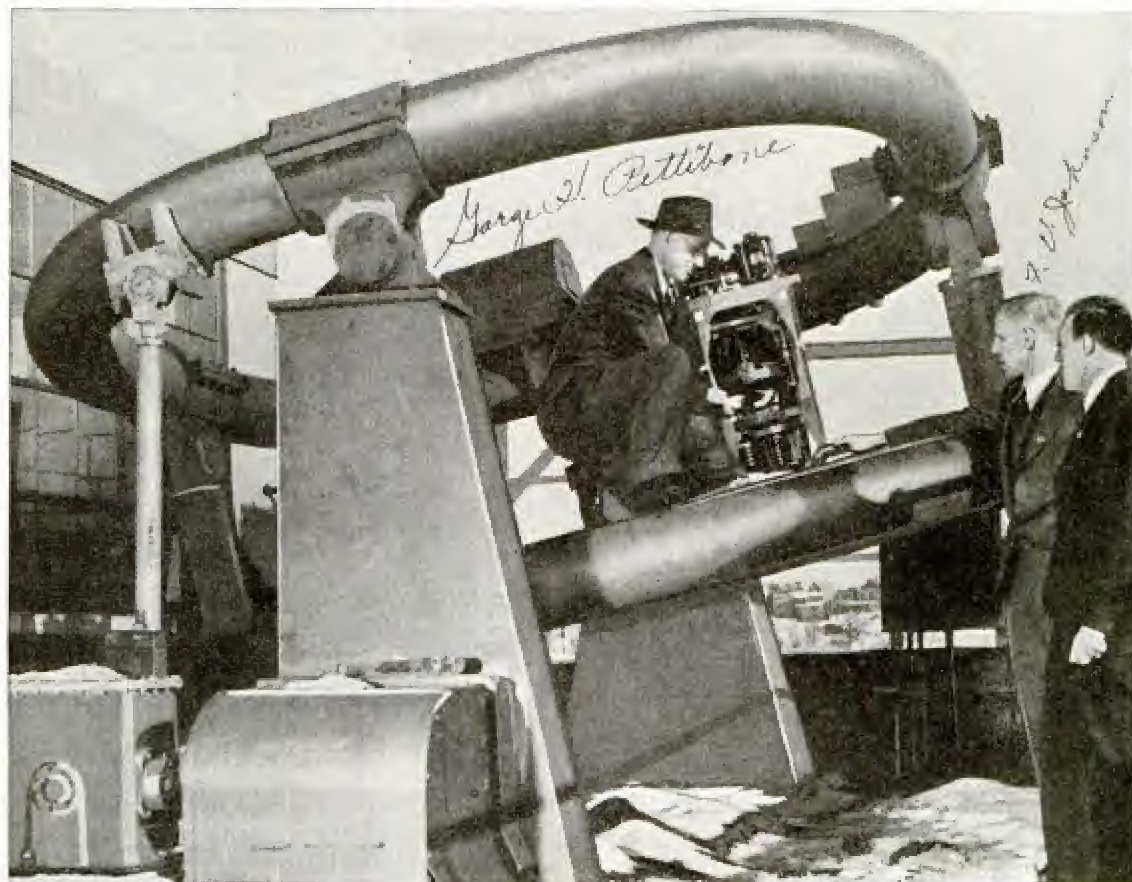
To aircraft makers like Mr. Timm, Tojo is not only getting louder but also funnier. Their answer to him is:

"Yes, Tojo, we are making planes of wood. And WHAT PLANES!"

Rugged, boxcar shape of Curtiss "Caravan" shows plainly in this view of plane under construction



Seasickness Machine Rolls Like Ship in Storm



Pitching and tossing motions of a vessel at sea are built into "seasickness machine," to test navy devices

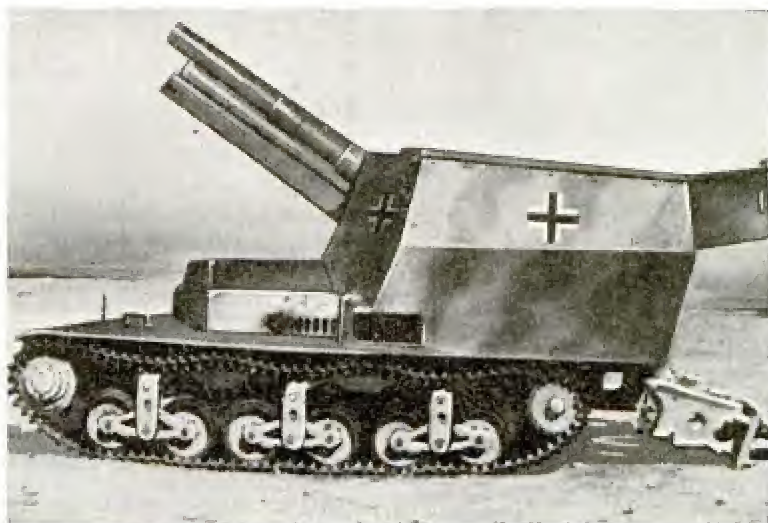
To test naval equipment under conditions approximating those on shipboard, General Electric has constructed a "seasickness machine," more formally known as the Scorsby tester, which has built in all the ups and downs of a warship plow-

ing the high seas. All the unpredictable motions of a vessel tossed by high waves can be simulated on dry land with the tester, and equipment can thus be tried for flaws without immobilizing or encumbering the ships needed for full-time duty.

Captured Nazi "Turret on Tracks" Propels 150-mm. Gun

Mobility of its heavy artillery was achieved by Rommel's Afrika Corps in the development of a self-propelled 150-millimeter assault gun, rolling on tracks similar to those used by tanks. The breech of the big weapon, as well as its crew, were hidden behind rugged armor plate, to protect the personnel during battle.

Nazi 150-mm. assault gun used by the Afrika Corps had heavily armored turret and was self-propelled



RUSSIA'S MESSENGERS of DEATH



Red snipers at front (above) blast away at foe and hope their fire won't betray hideout. Below, sniper uses telescopic sight



TWENTY-THREE-YEAR-OLD Lt. Vladimir Pchelintsev, Russian Red Army sniper, student of the Mining Institute of Leningrad, gymnast and mountain climber, is now a hero of the Soviet Union because his well-aimed bullets sent 153 Nazis to their death at the approaches of Leningrad.

Today Lieutenant Pchelintsev is training others in the art of sniping and is writing a book on the subject. As a boy, Pchelintsev took many prizes for rifle shooting. When he found himself in uniform at the outbreak of the war, he went to his commander and said: "I am a good shot. Make me a sniper."

The commander gave the young soldier a sniper-rifle with a telescopic sight. Pchelintsev's first shot went wide of the mark but he soon mastered the long range. By the evening of his first day, Pchelintsev had chalked up four dead Hitlerites. Since then, he has perfected himself in the intricacies of the art of sniping, learning to shoot in diverse and awkward positions: lying behind a stump, sitting in a tree, standing in some chance pit, stretched out on the ground, or literally doubled up.

Lt. Vladimir Pchelintsev
 322
 16th St.
 Phila. Pa.
 1930



Once Lieutenant Pchelintsev picked off an enemy corrector of artillery fire while lying in a swamp, his gun resting against a dry hummock, the rest of his body in water.

Another famous sniper of the Soviet Union is a young woman, Lt. Lyudmilla Pavlichenko, who had difficulty in getting herself accepted in the Red Army because even in Russia women are not considered suitable fighting material. At first, she was permitted to do only guerilla fighting, but she displayed so

Half-buried in snow, a sniper team waits for Nazi scouts. Below, Nazi by tree seen falling through telescopic sight



much skill as a sniper that she was made a senior lieutenant in the Red Army and decorated with the Order of Lenin.

Lyudmilla's record reached 309 Nazis, and she topped that off by training eighty other snipers who have killed some 3,000 Germans. Lyudmilla, now Lieutenant Pavlichenko, hopes that one of her pupils will beat her record.

Just why does the Red Army bestow such high honors and pay so much attention to the art of sniping? One reason is because the Germans are adept at the game. Lieutenant Pchelintsev tells of an endurance contest between a Russian and a Hitlerite sniper which illustrates the tenacity on both sides.

"The antagonists sighted each other si-

Waiting in ambush, sniper-scout's sharp eye scans countryside for enemy movement. He's alert to decoys



↑
Red sniper, invisible in the snow at 100 yards, shot 20 Nazis in a few days. Snipers change their position at night

Borrowing a trick from the jungle, sniper hides in tree. Nazi tree sniper is called a "cuckoo" by Russian guerrillas



Below, Red Army sniper crawls cautiously over rocky ledge after first testing for spotter by holding up hat on stick



multaneously," said Lieutenant Pchelintsev. "The German immediately dropped behind a stone and the Russian lowered himself into a shallow hole. They lay in these positions for four hours without once shifting their positions, for they both knew that the slightest movement would have brought a fatal bullet. Each one watched the other to see who could hold out. At the end, the endurance of the Red Army man triumphed. The German made a small but nevertheless noticeable movement behind his stone, thus exposing himself for a brief second, but long enough for the Russian bullet to find him.

"When I was a 'green' sniper, I used to open fire as soon as the enemy appeared, even at a distance of half a mile. Experience taught me to wait. Suppose I see a German coming along a path near a river. I wait. I am ready to shoot but I wait anyway. I hope he will bend over to take a drink. Just when he is motionless over the water, I shoot.

"Sometimes it is necessary to stay motionless for hours in a pouring rain, with water running down your face, under your clothes and into your boots. Sometimes during the winter a sniper has to be in the snow all day without eating a hot meal. The only way to keep warm is to wiggle your toes and fingers.

"Since movement spells death, however, a sniper must always wait cautiously before changing his position in the smallest way. He must wait and hope that the enemy will make the first move."

An important difference between sniping as it is practiced by the Russians and the Germans is that the Red snipers are

by no means confined to the soldiers of the Red Army. Among the civilians in occupied territory are many skillful snipers.

Guerrilla partisans take this oath: "For our gutted towns and villages, for the death of our children, for the tortures, violence and indignities suffered by our people, I swear cruel, merciless, and unrelenting vengeance on the enemy. . . If I betray, I must be killed at the hands of my comrades."

In the summer of 1941, the guerrillas had few weapons, and those few were poor. At first, they used old shotguns, rusty muskets, sabres made of old scythe blades, even pitchforks. Today, their weapons are better and their successes are recognized by the enemy. The Nazis are offering a reward of \$2,000 for the leader of a certain guerrilla detachment. All kinds of rewards have been offered for the capture of Lieutenant Pavlichenko. Both guerrilla fighters and regular army snipers are busy perfecting the art of sniping. At present every infantry unit of the Red Army has its first class sharpshooters and many army units have instituted classes for snipers.

At a conference of sharpshooters held recently, one of the questions concerned sniping in offensive operations. Some felt that a sniper could act effectively only if he could select his firing position, camouflage himself and wait for his prey; others were certain that sniping could also be an effective weapon in open fighting.

Sniper Ososov, for example, described his experience in selecting a position not far from a German blockhouse which he knew was to be shelled by artillery. Ososov took up his post at night, carefully concealing himself. At dawn, the Soviet artillery opened fire. Finally a shell struck the blockhouse, and the Germans dashed out.

This was Ososov's opportunity and he succeeded in making five out of seven Germans bite the dust.

Until recently, it was generally thought that a sniper had to travel as a lone wolf. At present, a new procedure is being tried out, called "volley sniping." A group of as many as six snipers under the command of a sergeant wait in ambush, concealing themselves in a trench, and then snipe at the enemy marching in groups along a road.

At the sniping conference, Sergeant Nazarov told how twenty Germans were seen coming along a path, walking in two sections. Sergeant Nazarov and his half dozen snipers opened fire on the first group, and succeeded in killing all six of them. The second group took to their heels, but two more volleys from the guns of the snipers brought down nine of them.

Another experience was reported by
(Continued to page 150)

Army 'Tent' to Combat Gas Folds in Small Package



Gasproof tent has a transparent top; note package

Alert to the danger of a desperate foe resorting to gas warfare, U. S. military experts have devised an individual protective covering for combat troops. The tentlike cover which has a transparent top repels liquid gas. When not in use it folds into a compact package easily carried in knapsack or pocket.

Oil Mixed With Coal Would Sink And Prevent Fires at Sea

Use of a colloidal combination of one-third coal and two-thirds oil would lessen the danger of fire at sea, and would save 15,000,000 barrels of residual fuel oil a year in war industries east of the Mississippi, according to the Bureau of Mines. Torpedoed vessels often present the danger of surface fires from burning fuel oil to crewmen leaping from the stricken ship. The colloidal fuel would sink instead of floating on the surface. Its use would also be justified as a conservation measure, since it would preserve natural oil supplies and utilize more of the coal reserves.

[To learn where to buy commercial products described in these pages, see the index.

U. S. Bombardiers Plan Noisy Axis Lullaby



"Axis transmitters left the air to-night, indicating new Allied raids." More and more often that news flash reveals the heart of the Axis is being pulverized with bombs. Evidence that the United States is abreast of the demand for more night raiders is seen in these shots of bombardiers at night rehearsal at a U. S. field. Left, bombardier climbs from "greenhouse" to report a "salvo of bull's-eyes." Below, cadets get camera as well as bomb-sight training. Oxygen-masked cadet, clad in sheepskin, crouches in belly of bomber-trainer, his camera ready to record classmate's hit



Floodlights cast eerie shadows as crews ready a training plane for flight to one of 18 nearby bombing ranges. Above, the plane's tanks are filled with gasoline. Right, crews load the craft with its practice "eggs." Ten 100-pound bombs go up with each of the dozens of ships in which the cadets wing away through the night skies on missions that for all practical purposes, at least, are identical with flights from airports in the British Isles to Axis targets in Europe. Training flights are made in all kinds of weather, to familiarize airmen with what they may expect in combat operations. A lighted night-time target viewed from 18,000 feet from "greenhouse" of bomber appears to bombardier about the size of a dime



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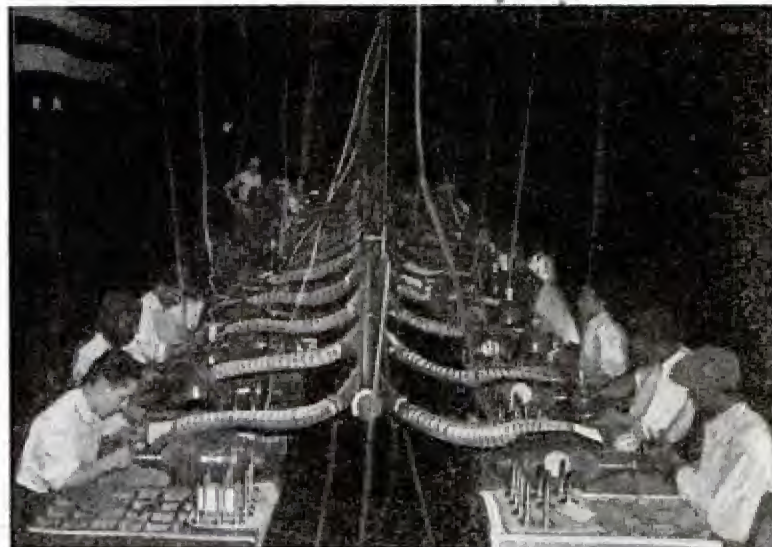
A black and white photograph of a man in a flight suit kneeling on the ground next to a vehicle. He is focused on a large, treaded tire, possibly a spare or a specialized tire for off-road use. The tire is mounted on a wooden or metal rim. The man is wearing a flight suit with a patch on the sleeve. The background is dark and indistinct.

Lifting yourself by your bootstraps is supposedly impossible, but the versatile army jeep just about manages that stunt. To climb a sheer embankment or traverse a ravine, however steep, the jeep literally winds itself upward on a rope. Big, detachable disks are fitted on specially prepared hubs of the rear wheels. Heavy ropes are fastened to the disks, the free ends being secured at the top of the embankment. The jeep is then placed in gear, and its slowly revolving wheels wind the rope onto the hub, lifting the machine to the top. For-



merly, to cross a ravine the banks had to be graded—a procedure that might take most of a day. With the new technique, any ravine or gulley of reasonable depth may be crossed in from 10 to 30 minutes.

minutes.
27 27
rinder



JULY, 1943

In an Ohio aircraft plant is a safety aid that resembles a mammoth centipede, between two banks of grinders. Its legs are the 52 inlets through which dust is sucked away from a polishing operation, at a rate of 25,000 cubic feet a minute. At 70 degrees Fahrenheit and about 12 inches static pressure, the machine whirls away 14,400 tons of air every 24 hours.

39

11/26

ADVENTURES of THE YANKEE



With shrouded headlights, bristling guns, two-jeep team starts out. Left, training raider to disarm enemy wielding a knife

By Thomas E. Stimson, Jr.

THE official communique read: "An enemy supply depot was destroyed last night by American raiders."

The terse statement gives only the results; what it doesn't mention is the story-book adventure of how it was done. It doesn't tell how six men of the armored ground forces blackened their hands and faces one night and stole out from behind our lines in a pair of quarter-ton jeeps. Even the headlights and the lowered windshields of the vehicles were shrouded to avoid reflections.

The communique doesn't tell how the little raiding party concealed itself in enemy territory all the next day, nor how, after dark, they advanced to the enemy rear and lay in wait beside a supply road. It doesn't mention how the men swarmed over one truck of a slowly-moving convoy, overpower-



3872- Franklin Ave.
Los Angeles, Calif.

RANGERS

ered the crew and kept their place in line, then drove right on in through the opened gates of the camouflaged supply depot. It doesn't mention the six-man whirlwind war that followed, or the details of using gun cotton and hand grenades to demoralize the camp and destroy the supplies of ammunition, gasoline, and food.

The supply dump was a small one, to be sure, otherwise a larger party would have been sent to destroy it. Not all the raiders returned, for this service is a dangerous one. But the supplies that were lost by the enemy helped decide the outcome of a larger fight next day.

Raiding the enemy is as old as war itself. Lawrence of Arabia was the outstanding hero of this kind of warfare in the last war; this time every army, including the British, Russians and Americans, use trained groups to harass the enemy. Raiding parties will never win a war by themselves, but the discomforts, disruptions and irritations they create help to wear down enemy resistance.

The British have named their raiders Commandos, while ours are known as Rangers. Nearly every part of the Army and Marine Corps have their own specially trained groups, and these individual groups have chosen distinctive names. Often they name themselves after their leader. "Gage's Gangsters" is the name of one group, "The Forty Thieves" is the name another bunch selected. "Terry and the Pirates" distinguishes a fighting team that was trained by Capt. Terry Overton.

Whether in Europe, Africa or the Far East, a raid-



American Ranger, bush knife raised, creeps up on careless "enemy" having drink



Right, raider with hands and face blackened, his tommy gun at the ready, is approaching enemy outpost. Below, favorite trick is fake radio orders to foe





U. S. Army Signal Corps photo

Half-track vehicle mounting antiaircraft gun roars across the desert on maneuvers. Men fight dust with handkerchief masks. Below, raiding party prepares daytime hideout by camouflaging jeep with netting and branches



ing party almost always uses army jeeps for transportation. These baby trucks are ideal because they are small and light, yet can be overloaded without breaking down. They have low silhouettes that make them difficult to spot by observation units on the ground or in the air, and they have four-wheel-drives that will push them through virtually any kind of country. They can travel fast and their fuel consumption is very low, important when you must

carry enough fuel for a long raid. The vehicles are grouped in teams, a light air-cooled machine gun mounted on the hood of the leader, with a two-way long range radio mounted on the second truck. In addition to three men and their knives and guns, each jeep is loaded down with water, gasoline, extra ammunition, canned food, camping equipment, sub-machine guns, wire cutters, and demolition materials. The men live off the enemy as much as possible and in an emergency they can call by radio for supplies to be dropped by parachute. Extra fuel cans are lashed to the sides of the vehicles. Camouflage nets are carried for concealing the trucks during the day and when the men sleep they do so with their arms beside them. A raiding party may consist of from six to 100 men, depending on the particular mission.

What are some of the things they do? One thing that they won't do is engage in a fair fight. The enemy would like nothing better, but these men are a thousand times

Jeep loaded for raid with fuel cans, sleeping bags, guns, food, ammunition and three-man crew



more dangerous in their own way. Their job is to strike and run, using Indian tactics to find enemy soft spots and destroy them.

They like to slit the throats of a few sentries at an enemy bivouac, then steal away without alarm. Tomorrow night, they know, the enemy will double its guards and still sleep uneasily. They like to raid a command post and dispose of the officers. In fact, raiding anything from a field telephone exchange to a general's headquarters is one of their main purposes. They like to issue false and confusing orders to enemy units by radio, for one of the raiders was selected because he can speak the enemy language. They like to overpower a traffic guard at a lonely intersection after dark, then place one of their own men there instead for a few hours to direct troop and supply convoys down the wrong road. They change the directions on military road signs that the enemy has erected. They dispose of the guards at a tank or artillery park, then blow up as many of the vehicles as they can. They are trained to attack with bloodthirsty ferocity and they delight in destruction.

Each time a raiding party is made up, its members are selected for the special task to be done. The weapons they carry depend on the job. Each man bristles with weapons and even if you should remove those that you can see, a raider still has a knife or two concealed in his clothes.

What kind of men are selected for Ranger



Black-faced raider shows how to use knife on an enemy sentry

duties? Men who a few months ago might have been clerks or college boys or gas station employees or farm hands. Many of them have been athletes and have done a lot of hunting. It's surprising in how short a time such men can be revamped into cold and ruthless experts in the art of crippling the enemy. The only way you can get into a Ranger group is to volunteer, applying to your commanding officer for the assign-

(Continued to page 146)

Leader of a two-jeep, six-man team outlines a night's work to his hard-hitting crew. It may be a raid on a command post, field telephone exchange or a general's well-guarded headquarters



Frank Clark, 68 Lexington Ave., Akron, Ohio

Steel V-Belt for Tank Motor Outlasts Cotton-Cord Type



Steel V-belt is friction tested for high-speed operation

Endless strands of steel cables are used in place of conventional cotton cords or fabric in a V-belt adapted to the engines of rough-riding army tanks and motorized vehicles. Developed by the Goodyear Tire & Rubber Co., which reported the metallic type showed many times longer service-life than the best cotton-cord belts in a series of tests, the steel belt was found to stretch less than one fifth of one percent. One of the tests simulated the friction the metal belt would be subjected to on an automobile speeding at 80 miles an hour.

Barnacle Is on Side of the Allies In Slowing Down Axis Ships

Pest of the seven seas, the lowly barnacle is an ally of the United Nations. It attaches itself in large numbers to ships without regard to flag, of course, but whereas the vessels of the United Nations can readily enter port to have the barnacles removed, the enemy in the European theater finds such removal hazardous because his ports and docks are under constant threat of attack from the air. Barnacles slow ships, make them less maneuverable, and in-

5401 Hamilton Ave. Cleveland, Ohio

crease fuel consumption, according to officials of the Osborn Manufacturing Co., which makes brushes to help remove them from ship keels. In fact, the Graf Spee is thought to have been unable to fight attacking British cruisers to best advantage because of a heavy accumulation of barnacles on her hull.

"Fishbowl Hat" for Plane Tester Protects Him at 92 Below

In the \$45,000, three-room "ice box" in which parts of Republic's Thunderbolt (P-47) pursuit plane are tested, the temperature can be lowered to 92 degrees below zero, Fahrenheit, even exceeding the brittle cold of the stratosphere. Researchers inside wear regular army flying garb—sheepskin lined boots, trousers, coat and gloves, but instead of a helmet their headgear is made of Lucite, shaped like a fish bowl for clear vision, with dead air between its two layers to reduce transmission of cold to a minimum. In temperatures under 20 below zero they also breathe pure oxygen from a portable tank, to safeguard lung tissue from freezing and ultimate pneumonia. Their work includes checking the freezing points of oils and greases, or testing parts under temperature conditions more severe than can be expected in flight. Hydraulic and electric lines are run into the cold rooms, or a landing gear may be set up in a jig and the hydraulic cylinders operated so that the effect is exactly the same as the shock when a Thunderbolt drops on a cement runway. The 12-inch walls of the cold rooms are layers of metal separated by spaces of dead air.



Lucite helmet permits clear vision in cold-test room

Iron Horse Gets Facial With Feminine Touch



Scrubbing locomotives has by long usage been exclusively a man's job, but the Long Island Railroad has hired a feminine quartet to do the work and release men for more vital war tasks. Inset shows women working on tender; in the other, long handled brushes give the cab a rubdown



The distaff side isn't limited to work in yards. Control boards of Pennsylvania switch tower (above) and of signal tower, (right) are also "manned" by women. In many cases, the women volunteering for railroad work have male relatives who are in the services, and often they replace men who have gone to war. Women are maintaining lanterns, or "jewelry" in railroad lingo, and the water cans that provide drinking water for crews. Women volunteering find the work hard but healthful

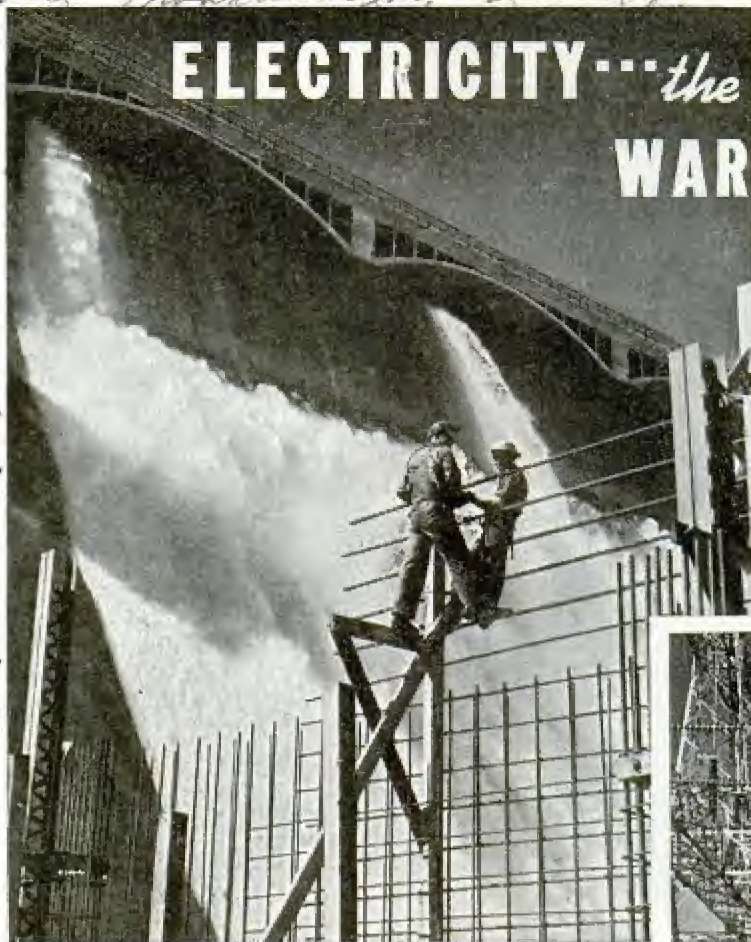


JULY, 1943

Lillian Redmond
of Empire

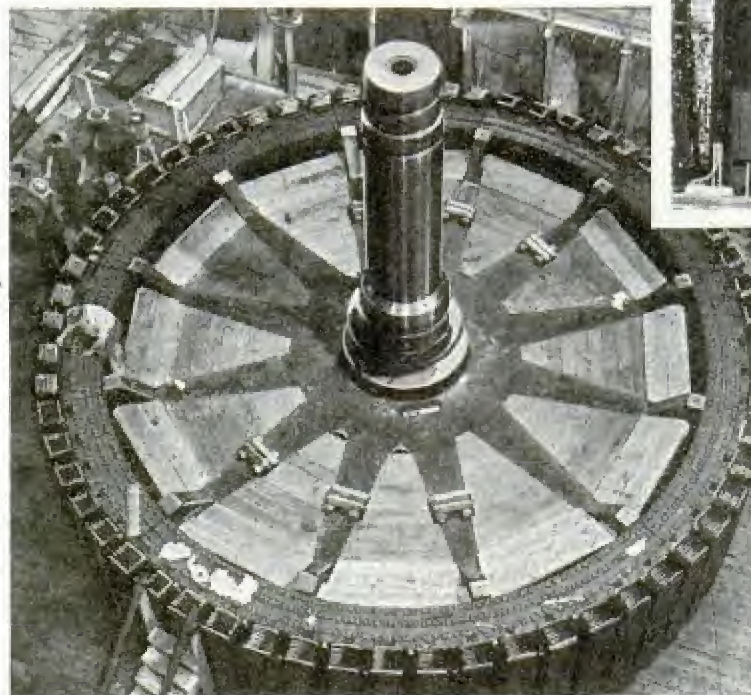
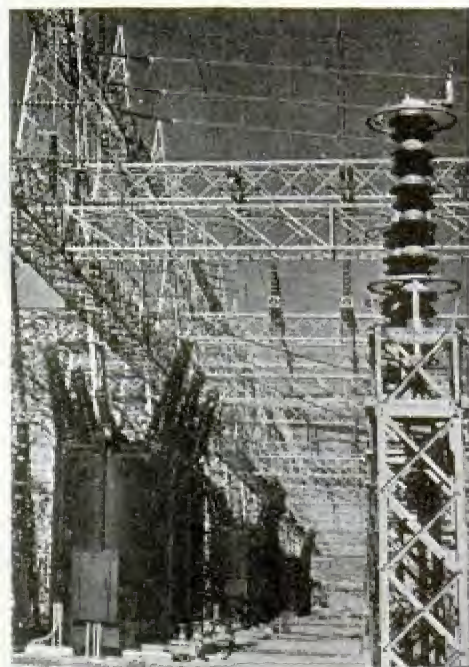
Art: Thomas C. Stinson, Jr.
3872 Franklin Ave. Los Angeles, Calif.

ELECTRICITY...*the* MIGHTIEST WAR RIOR

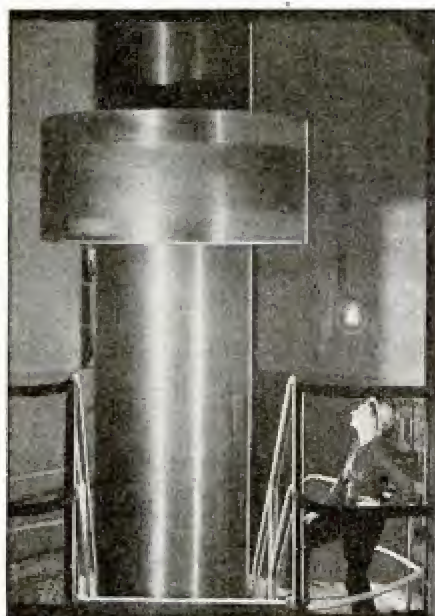


It takes 220,000,000 kilowatt hours of electric energy in the construction of a battleship—637,000 to build a Flying Fortress. It would take a billion workers to perform the war job done by American workers with the help of electricity, for if one man carried a 50-pound load up a flight of stairs for eight hours daily his work for an entire year would equal that of only 20 kilowatt hours. Giant dams help produce the needed power

By harnessing the waters of the Columbia River, the Grand Coulee Dam (above) supplied 278,000,000 kilowatt hours of electricity to war plants of the Pacific Northwest in a single month. Right, network of towers, wires, carry power



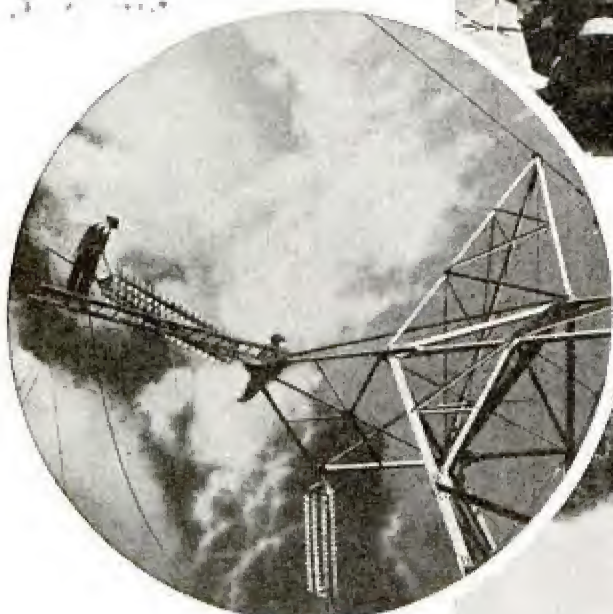
Putting the hum into big plants building ships, tanks, planes, is the huge 587-ton rotor (left) for one of Grand Coulee Dam's three 108,000 kilowatt generators—the world's largest. The federal Bureau of Reclamation has installed many large wheels of this type in western dams to boost the hydro-power output to meet the needs of new factories. Without added source of power, America could not produce vital aluminum needed for warplanes



↑ This mighty shaft, four feet in diameter, 73 feet high and weighing about 200 tons, enables waterwheel of Grand Coulee's turbines to turn generators

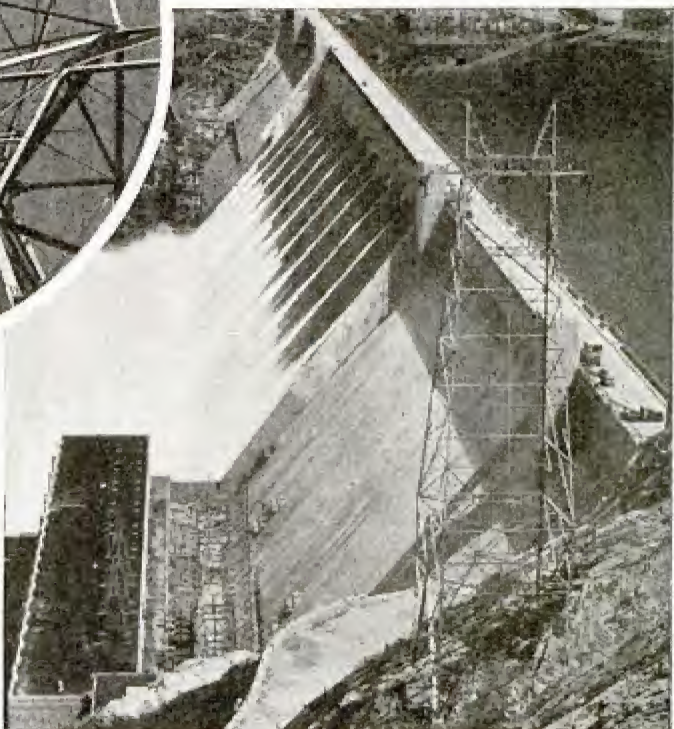


The warriors above wear helmets, too, but their job is not killing Japs or Nazis. They are constructing switches outside power plant



↑ Two daring linemen attach strings of insulators to one of the circuits joining the two Columbia River dams, the Bonneville and the giant Grand Coulee

Bird's eye view of Grand Coulee Dam—world's largest concrete structure. In less than two years this dam became one of world's major power producers, a monument to U. S. foresight, ingenuity



Glasses Enclose Light Bulbs For Reading in the Dark



Bulbs in blackout glasses operate from tiny battery

"Blackout" eyeglasses, with a tiny electric light bulb attached to each eye frame to give enough light for vision at close range, are the invention of a New York optometrist. Heavy lenses keep the glare out of the wearer's eyes. The units are self-contained, operated by a pocket-sized battery. Because the tiny bulbs show no light at a distance, the glasses are considered useful for wear during blackouts.

Candle Lights Blackout Lamp With Three-Colored Beam

Designed for use in blackouts, a hand lantern with a grip like the handle on a

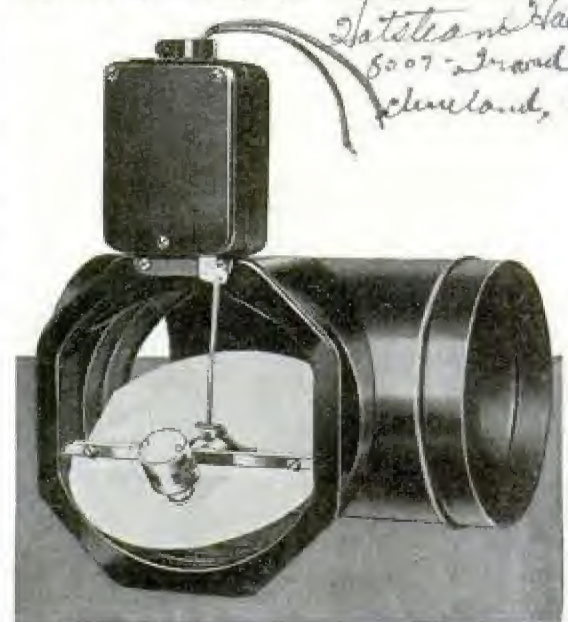


Lantern has red, white and blue panes for signaling

drinking cup is constructed to throw the light at a slightly downward angle, and its source of light is a candle said to have a life of 24 hours. The window through which the light shines is adjustable to three different colors, red, white and blue. Besides its use as a light during blackouts, it could also be used as a motorist's danger signal in making roadside repairs.

Draft Control in Furnace Flue Assures Maximum Heat

Capable of being fitted in the flue pipe of any domestic heating equipment to obtain maximum heat from the fuel burned, barometric draft controls offer a means of "balancing out" the fluctuating amounts of draft or vacuum furnished by the chimney. The balanced, counter-weighted metal air valves are designed to insure a steady, unchanging rate of draft in the furnace. One model is equipped with an electric controlling motor, especially useful with automatically fired equipment. Such



Automatic draft control is designed to save fuel

equipment generally starts and stops in direct response to the action of a room thermostat. When the burner cuts out, there is no longer need to draw the gases of combustion through the boiler, and furnace draft naturally increases. This increased suction draws large quantities of cool air across the heating surfaces, rapidly cooling them, and when the burner is again started by the thermostat it is required to restore this loss of heat. The motorized draft control minimizes the cooling action by arresting excessive draft and air flow, automatically swinging the flutter wide open to check the flow.

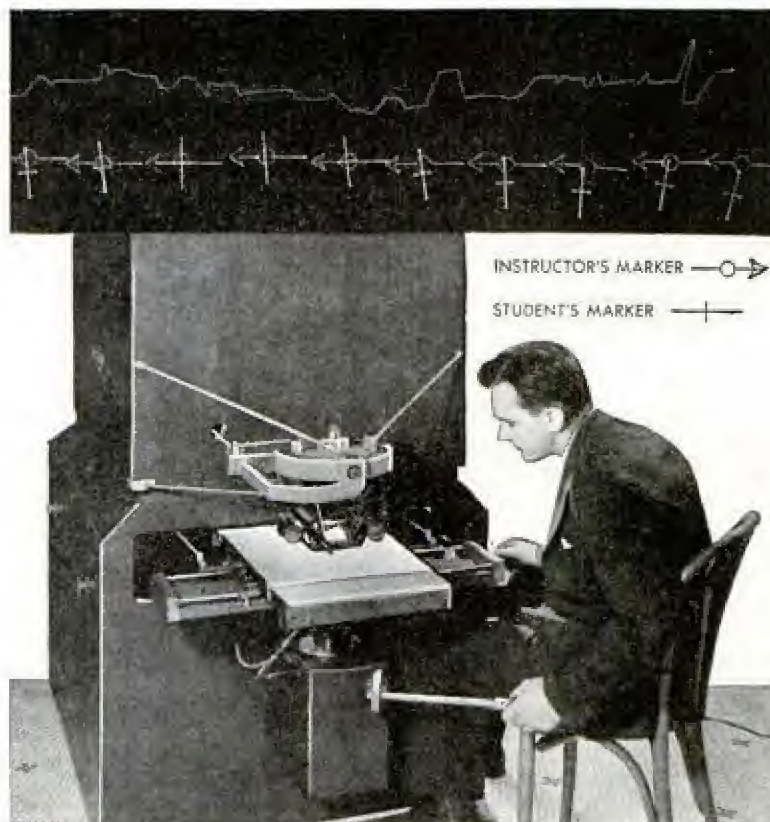
W. Sidney Park, Park Aerial Surveys, Inc.
303 Realty Bldg., Louisville, Ky.

17203

Tilt Cabin on Turntable Trains Aerial Photogs

Students are taught to take accurate aerial photographs without either leaving the ground or actually taking any pictures in a training device developed by W. Sidney Park, president of the Park Aerial Surveys, Inc. It consists of a cabin mounted above a movable table. The cabin itself may be tilted by the instructor to simulate the tilt of a plane in flight, and the table may be canted to imitate drift, and moved back and forth. The student is obliged to compensate for these movements by adjusting the position of his camera. Detail on a film transparency is projected into the student's view finder, and as the table is advanced it simulates the movement of the ground beneath a plane. A recording device is marked with straight lines to represent the line of flight.

Twin printers record the "difficulties" introduced by the instructor, and also how well the student allowed for them. A crossed line marks the manner in



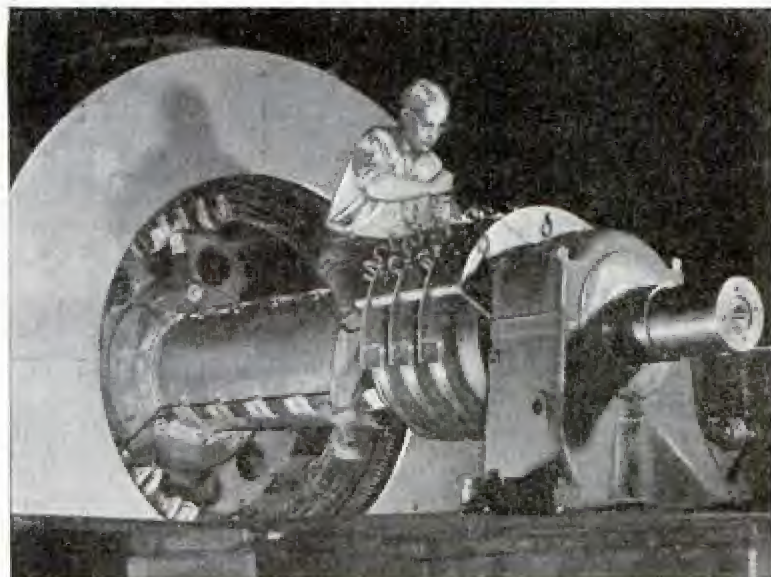
Camermen take "aerial pictures" on the ground in trainer simulating tilt and drift of plane, and recording accuracy of student's periodic "shots"

which the instructor simulated deviations from the line of flight, and circled arrows record the "pictures" taken by the student.

I. N. Graham

7/134

Wind Tunnel's Hurricane-Maker Is Giant Electric Motor



Motor to drive propellers in wind tunnel weighs as much as 30 automobiles

Weighing as much as 30 automobiles and packing enough power to whip up winds of hurricane proportions, a giant electric motor made by Westinghouse is one of a battery which will help test the effectiveness of American warplane models in an air field wind tunnel on the west coast. The motor drives giant propellers to enable engineers to check on a plane's performance under flight conditions.

⌈Treating wood for fire resistance takes from three to three and one-half pounds of chemical per cubic foot of wood.

Raft Pops Out of Fallen Plane To Save Pilot Down at Sea



Before his cracked-up plane sinks, pilot can reach pop-out raft

When a plane makes a forced landing at sea the pilot may be so engaged in making the crash landing that he would have no time to throw his collapsible life raft into the water before the plane noses under, so "pop-out" rafts are installed to safeguard the pilot's life. At the crash, the raft, with its inflation valve automatically released, pops out into the water, and is held by a painter to the plane until compressed gas inflates it. If the plane goes under before the pilot can step into the raft, the painter comes away, because it is set to break at a predetermined pull, less than that exerted by the sinking plane.

Pound Saved Is \$2,000 Earned By Big Transport Planes

One pound's reduction in weight in a commercial plane like the Douglas DC-3 increases its revenue during its operating life by approximately \$2,000. A 5 percent saving in fuel consumed by a 2,400-horse-

L. T. Miller
Glenn L. Martin Co.
Baltimore, Md.
power plane means a 1,080-pound reduction in the weight of fuel carried on a 20-hour flight, and a revenue increase of more than \$2,000,000 during the plane's life span. In a military plane, this small saving in fuel would enable the craft to carry two 1,000-pound bombs instead of one. To achieve such flying thrift, an improved carburetor may be worth a cost equivalent to the rest of the engine, either in dollars or in the man-hours required to produce the carburetor, according to L. T. Miller of the Glenn L. Martin Co.

Slugs Sorted From Coins With Endless Belt

Cities using parking meters may, like San Diego, sometimes find the motoring public resorts to the use of foreign money, iron washers, slugs and other metallic discs to "beat" the tiny parking fee. To sort these objects that are not legal tender from the coins collected from the parking meters, all are dumped into a hopper from which they feed down onto an endless belt, driven by a hand crank. A baffle forces the pieces to lie flat, and with his free hand the operator picks out the counterfeit pieces, leaving the coins to fall into another receptacle.



Hand-turned endless belt lets inspector reject slugs

Ref: M-1200

Mr. W. Bingham
National Graduate Council Committee
William Bingham

UNCLE SAM PICKS *an* ALL-STAR TEAM



Finding the right man for the right job in the army starts with aptitude tests

By Wayne Whittaker

ANY sandlot baseball player knows the importance of picking the best man as pitcher, catcher or first baseman. If the fellow with the best curve ball is wasted in the outfield, the chances are you'll have not only a punk team but one lacking team spirit. In the army they call it esprit de corps—the stuff that builds champion teams and victorious armies in which each man is doing the job he does best.

Right now Uncle Sam is in the midst of building the biggest all-star team in history to whip the Axis. Millions of men in the "lineup" from every walk of life—farmers, engineers, clerks, salesmen, lawyers, tea-tasters, musicians and truck drivers—must perform some 2,000 specialized jobs in the U. S. Army.

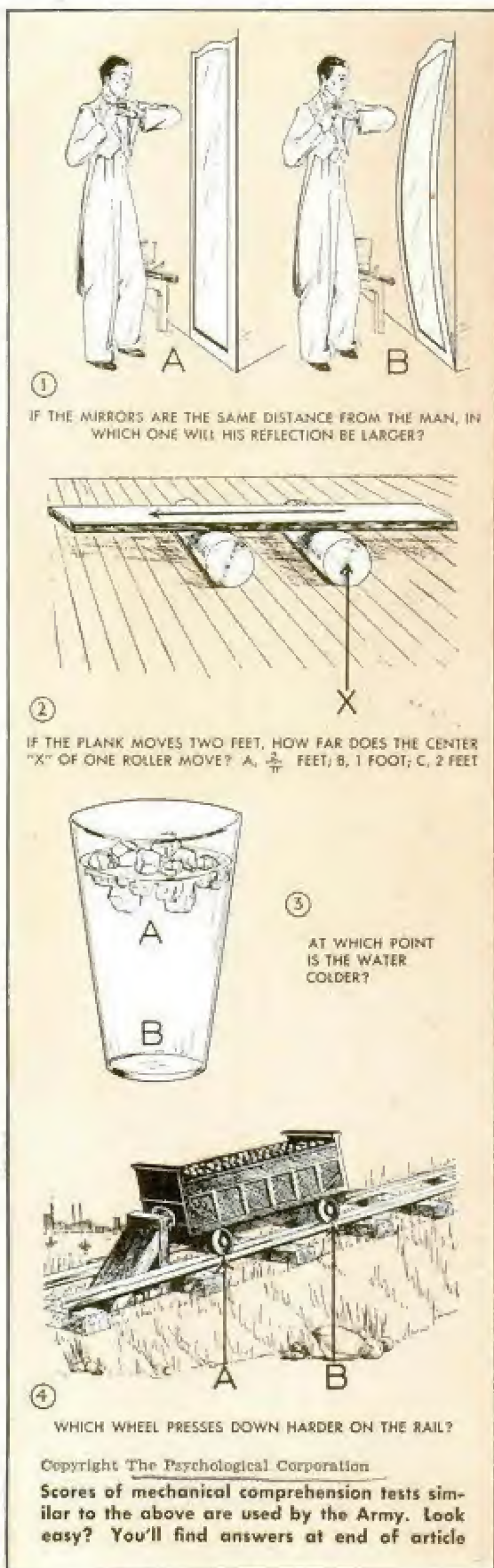
Every man who reports at an induction station is a candidate for one of those 2,000 jobs. They range alphabetically from "able seaman" (this army oddity is explained by the harbor defense units in the Coast Artillery Corps) to "yardmaster."

The gargantuan task of finding the right man for the right job, whether it be as navigator on a bomber or gunner on a tank, is performed under



Above, testing reaction time of cadet with rudder bar and joystick. Below, pin-in-hole test for steadiness





U. S. Army Air Force photo

Red and green lights flash on board indicating certain levers to be pulled to test alertness

the jurisdiction of the adjutant general's office. More than 600 officers and 6,800 enlisted men and non-coms select and conduct the tests that decide whether Bill Jones is slated for the signal corps or field artillery.

Working under pressure, the classification experts have marked up a record that assures Bill his chances are 20 to 1 of being classified correctly. How do they do it? With a general classification test, mechanical aptitude tests and interviews. The personnel men say it's the interviews that really "get under the soldier's skin."

The interviewers are skilled in getting a man to talk about his hobbies, what he does in his spare time, the sports in which he excels, the books he reads. Does he like to tinker with the radio? Did he build a canoe when he was a Boy Scout? Only when interviewers are faced with a blank wall of youthful inexperience, reticence or indifference do they write "branch immaterial" on the man's qualification card.

One sergeant was at his wit's end after a long and fruitless interview with a silent coal miner. Finally, the miner recalled that he had been a "right smart" deputy sheriff of his county at one time. Now he's one of the best military policemen at a big camp in the Rocky Mountains.

Among the first things the army psychologists learned was that civilian occupation is often a poor guide; hobbies frequently have greater bearing on a man's assignment. At one school for army cooks there were an unusual number of failures although every man had been working as a cook before his induction. Classification officers discovered the men who failed hated the work. They had been working as civilian cooks because they could not get other jobs. All were reclassified.

522 - 3rd Gen.
MJC.

Frank J. Davis
Boston, Mass.
Kidd
N.Y.C.
↓
James McCallum
New Orleans, La.

Bob F. Ryan
N.Y.C.

Albert Krebs
Newark, N.J.



This "turning peg test" quickly reveals control and nimbleness of fingers of an aviation cadet

One inductee at Fort Dix told an interviewer that he had been a shoe salesman in Brooklyn. As this suggested no particular assignment, the man was encouraged to talk about what he did in his spare time.

"Well, I never did much," the shoe salesman replied. "When I came home at night I'd eat dinner and read the evening paper or listen to the radio. Occasionally take in a movie. Couple times a week a neighbor would drop in with a radio to be repaired and that's not much of a job for me."

The sergeant let out a whoop. Not much of a job! Radio technician—with the army in desperate need of them. Good radio men are rated No. 1 on a list of 181 army shortages. The interviewer who can write "radio technician" on a qualification card lays it before his superior like a diamond on a tray.

The clients of two former insurance men are probably still shaking their heads over their assignments. One was sent to the mountain troops near Mount Rainier, Washington; the other was set to work training war dogs. The officers who interviewed them found that one had been an expert skier in college and the other had a hunting setter he had trained to "do everything but talk." Both men are having the time of their lives in the army.

Frustrated talents are discovered with unsurprising—at least to the personnel workers—frequency. Many a man doomed to mediocrity in his civilian job has become a first class army technician because he is doing the job for which he is best fitted.

Sometimes there is a backlog of men for certain jobs. The outstanding example is that of lawyer. There are many more lawyers in the army than the judge advocate

A

B

C

D

E

5 WHICH SITUATION PUTS MORE STRAIN ON THE ROPE?
(ALL THE MEN PULL EQUALLY HARD)

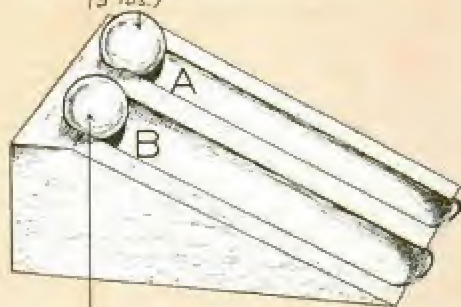
6 IF THE BALLOONS WEIGH THE SAME AND CONTAIN THE SAME VOLUME OF GAS, WHICH ONE WILL FLOAT HIGHER IN THE AIR?

7 WHICH IS THE BETTER WAY FOR THE TUG TO BRING THE BARGE TO A DOCK?

8 WHICH WAY WILL THE UPPER ROUND ROD STAY BALANCED MORE EASILY?

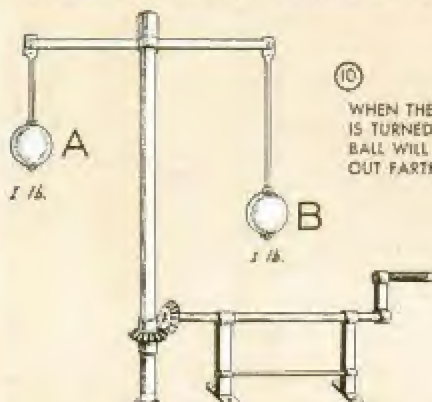
Copyright The Psychological Corporation
Tests like these reveal recruit's aptitude along mechanical lines. Speed counts as well as accuracy. See answers at end of this article

HOLLOW IRON
(5 lbs.)

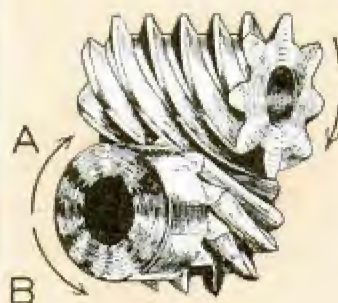


SOLID ALUMINUM
(5 lbs.)

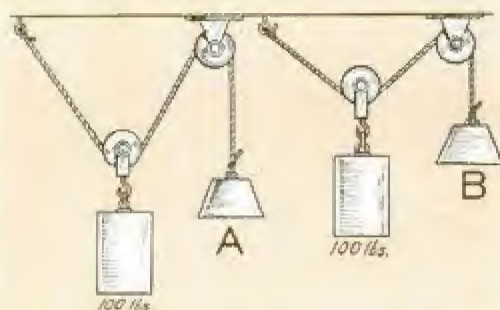
IF THESE TWO BALLS WHICH WEIGH THE SAME ARE LET GO AT THE SAME TIME, WHICH WILL REACH THE BOTTOM FIRST?



WHEN THE CRANK IS TURNED, WHICH BALL WILL FLY OUT FARTHER?



IF THE UPPER GEAR TURNS IN THE DIRECTION SHOWN, IN WHICH DIRECTION WILL THE LOWER GEAR TURN?



WHICH WEIGHT MUST BE HEAVIER TO SUPPORT THE 100 POUNDS IN THE POSITION SHOWN?

Copyright The Psychological Corporation

If rookies pass tests like these with a high score they are mechanic "hopefuls." Try them, then check the answers at end of this article



The score in this test depends on perfect co-ordination of hands on the two control levers

general can ever use. There is also an abundance of prospective aerial photographers, as one young salesman from Los Angeles discovered recently.

His case is a good example of how the army sorts its men with a practical eye on the needs of the military forces and the abilities of the individual. There are four stages in this sorting process: No. 1—induction station; No. 2—reception center; No. 3—replacement training center, and No. 4—tactical unit.

John B., the 24-year-old salesman from Los Angeles who sold photographic supplies, hoped to become an aerial photographer. At his induction station a medical board made sure that he was physically and mentally sound. This is the point where the army saves valuable time and money by weeding out the unstable. There is no place for nitwits, crackpots or neurotics in the army.

Passing the medical tests, John was sent to one of the 38 reception centers where he was given the general classification test. This test gauged his general knowledge and mental capacity at 110, qualifying him as officer candidate material. Inductees who pass this test with a grade of over 100 are labeled "pace setters."

Next, John was given the mechanical aptitude tests, also at the reception center. These tests consist of scores of illustrated problems. Which will hit the ground faster, a ball thrown straight out from a cliff or one dropped over the edge? (John guessed correctly on this one—a tie.) Many of the problems concern pulleys and gears with right and wrong adjustments.

Following the tests John was interviewed for the first time. His name, age, size, education and civilian occupation were duly entered on his qualification card that will

follow him like a shadow until he is mustered out of the army. John told the interviewer of winning prizes in amateur photography and of his desire to become an aerial photographer. In the space to note John's qualities for leadership, the interviewer wrote "maybe."

After four days at the reception center, where he was outfitted as well as classified, John was assigned to the Army Air Force and sent to a replacement training center. There he received 13 weeks of basic military training, exchanged a few pounds of fat for muscle, and took more tests to determine his qualification for specialist courses given at different fields. Again, he was interviewed and asked to state his preference which was still aerial photography.

John was told that he was qualified for this type of work, but that there was a backlog of candidates for this particular job. The army was satisfied that John was also fitted for several other jobs in the air force including that of instructor on the Link trainer. There is a shortage of instructors. John chose the job of Link trainer instructor and was sent to a tactical unit for training. He has never regretted the choice, he says. After the war he sees a new career for himself in civilian aeronautics. Like thousands of other soldiers, he praises the classification tests as "fair and sensible."

The air corps has had excellent results with tests for selecting pilots, navigators and bombardiers. Candidates are subjected to a mental obstacle course that saves expensive guesswork by reducing the number of "washouts." Written tests range from mathematics to map reading and odd-looking machines reveal steadiness, hand and arm dexterity, and a man's ability to think fast.

In the steadiness test the prospective pilot or bombardier holds a pin-sized stylus in a nail-sized hole. Each time the stylus touches the edge an electric charge scores one point against him. While he is taking this test the soldier is the object of scientific heckling. A hunk of metal drops with a nerve-shattering crash on a sheet of tin behind him. Horns honk unex-

(Continued to page 146)

Pipe Organ Made From 270 Cans Has Range of Five Octaves



Varnish-coated cans forming organ pipes were useless for scrap

Odds and ends rescued from the junkyard, including 270 cans that were useless for scrap because of the varnish inside them, were reassembled by an ingenious Philadelphia aviation mechanic and converted into a full-sized pipe organ, with a standard five-octave keyboard. Into the instrument also went old wire and parts from pinball machines.

Lumber Spot-Welded by Radio Waves To Utilize Waste Boards

Heat produced by high-frequency radio waves is used to spot-weld with glue pieces of lumber that were formerly wasted. Such waste stock, produced when logs are squared off, can be joined into wide boards by smearing the edges with a cold-setting type of glue, then applying the radio heat. The method, according to I. F. Laucks, Inc., chemists, employs only momentary pressure, eliminates clamping, and does away with heating the whole glue line. General setting of the glue line takes place after the boards are stacked, cutting down the time they must be in the gluing machine.

ⒸGlass eyes have been improved to the point that a good eye now will last about two years.

*I. F. Laucks, Inc.,
917 Western Ave.
Seattle, Washington*

COMBAT-- *The* SCHOOL of DESIGN



Out of the smoke and fury of battle come new ideas to keep our war machines two jumps ahead of the enemy

A FIGHTER pilot soaring 40,000 feet above the desert scratches at the frost on his windshield.

A tank commander in the dust of battle makes a desperate try to budge a turret jammed by enemy bullets.

A gunner skins his knuckles on a control.

The crew of a low-flying bomber over a Jap position drops a bomb and is lifted a couple of hundred feet by the concussion.

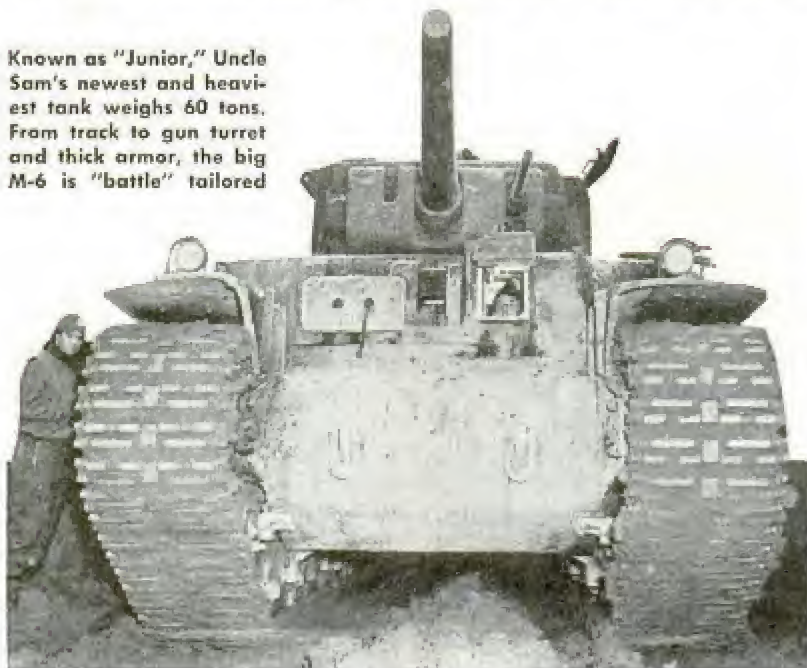
When things go wrong—or right—in battle the combat crew sets up a howl—or cheer—that is echoed thousands of miles away in U. S. war plants. Designers of fighting equipment have their ears tuned to the fighting fronts, for combat is the real school of design.

Back in the early days of the war when Flying Fortress crews were combatting swarms of Jap Zeros over the Philippines,

they clamored for tail guns. The Fort's designers and engineers got busy and soon the Japs got an unpleasant surprise. When Fortresses with "stingers" in their tails were put into action more than 100 Zeros were blasted out of the sky over New Guinea before a single Jap could get back to report that the once-happy game of "tailing" a Fortress had a new .50-caliber name: "Meet the ancestors."

Since that time, the Boeing Company, makers of the Flying Fortress, has kept service engineers in combat zones who re-

Known as "Junior," Uncle Sam's newest and heaviest tank weighs 60 tons. From track to gun turret and thick armor, the big M-6 is "battle" tailored



lay suggestions by the crews to the home office. That is part of the reason for more than 400 changes on the newest Fortress, the B-17F.

Among the first to stress the combat school of design was Col. Eddie Rickenbacker. When he returned from his first inspection of U. S. bases overseas he urged airplane manufacturers to send their chief engineers at least once and preferably twice a year to the fighting fronts. Today major aircraft companies, Douglas, Consolidated, Lockheed, Wright and others have experts close to theaters of operation.

These experts work in co-ordination with officers of the air force and engineers at the army's aeronautical laboratory at Wright Field. In the same manner, engineers of the War Department's Tank-Automotive Center work with the officers of the Armored Force behind the front lines. Soldiers, usually those with some engineering knowledge, shuttle back and forth between fighting fronts and war plants.

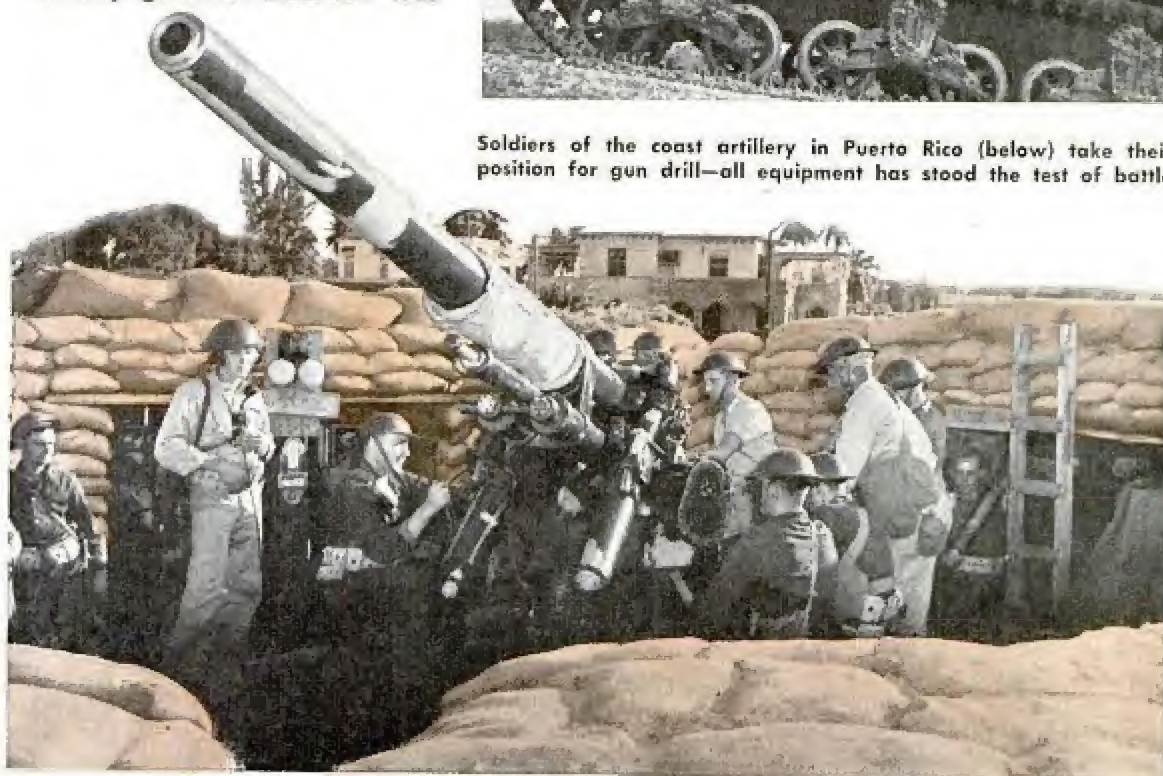
Many of the changes dictated from the field of battle are still military secrets. They will be closely guarded until the War

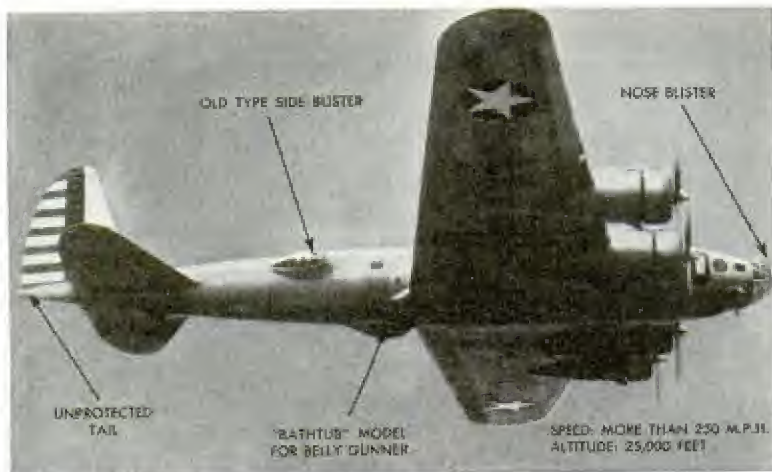


The M-4 tank (above) was virtually designed in combat and is an improved model of the lofty M-3 (below) which has gun on one side
Signal Corps photos

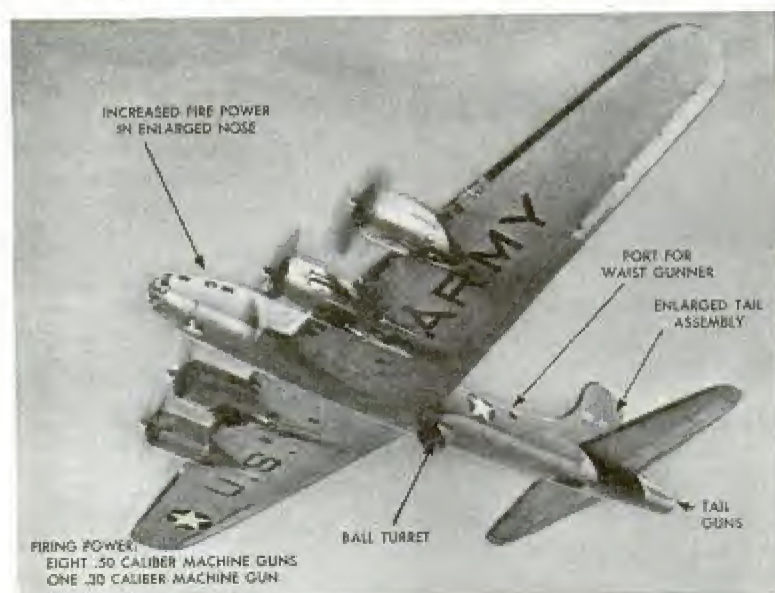


Soldiers of the coast artillery in Puerto Rico (below) take their position for gun drill—all equipment has stood the test of battle

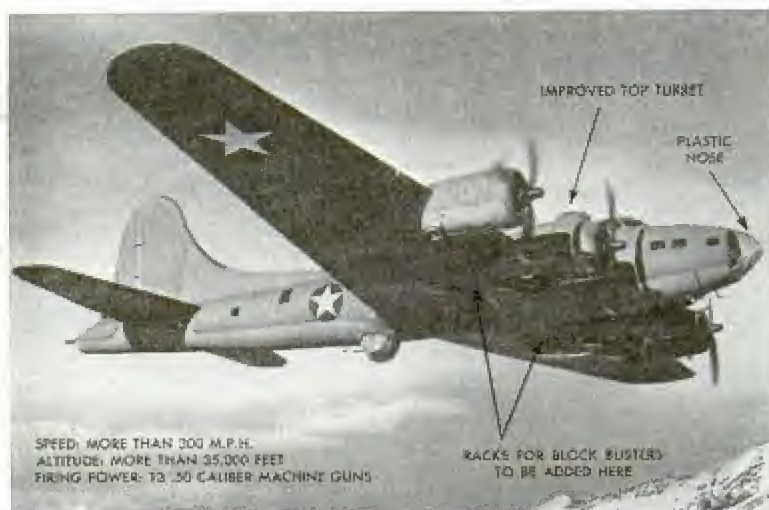




Partial evolution of the Flying Fortress, famed Boeing B-17, is shown on this page. Above, the vulnerable Model D used in early stages of war



From lessons learned in combat, the Boeing Aircraft Co. designed powerfully armed Model E (above) which shoots down enemy fighters by scores. Latest model, the B-17F (below) added some 400 additional improvements



Department has definite proof the enemy has possession of them. When a "secret weapon" like the M-7 tank destroyer is thrown into battle it isn't a secret for long because 105-mm. guns don't speak in whispers. And when Flying Fortresses roar over France shooting Goebbels-glorified Focke-Wulf 190's from the skies like locusts, it's no secret that each plane boasts 13 deadly .50-caliber machine guns.

The evolution of the Flying Fortress, which has been called America's greatest single contribution toward winning the war, is typical in the story of changing designs to keep two jumps ahead of the Axis. The great four-motored bomber has already passed through models A, B, C, D, E and F. The first Fort to be tried out by the British was the C model with minor changes requested by the RAF. American fliers entered combat with the D. In both C and D models the nose and side blisters had been removed, but the "bath tub" underneath designed for rear protection still remained.

Then the Boeing Company, profiting by lessons learned in combat, designed the B-17E. This model was a major change from the D and a far cry from the original Fortress first tested in 1936. The stinger turret was added, necessitating enlarged horizontal and vertical tail surfaces. Its fire power was increased to nine machine guns, eight .50-caliber and one .30-caliber. (Combat crews are quick to report any "blind spots" that need protection.) The astradome in the top, used by the navigator, was removed and the navigator's position was moved from back of the pilot up

to the roomy nose section just behind the bombardier. The "bath tub" was replaced with a power ball turret and another power turret was built in the top. The E was also equipped with improved armor and leakproof gasoline tanks.

The Boeing Company might have been tempted to freeze the design for the duration, but it didn't. Before the E was rolling from the assembly line the F model was on the boards. When the switch was made to the F more than 400 changes were made including 13 instead of eight .50-caliber guns, an all-glass nose and provision for an increased bomb load. This switch was made, incidentally, without any falling off in production.

Already the B-17F is being improved to make it the greatest bomb carrier in the world. Special racks under each wing, which are added at modification centers so as not to interfere with production, will enable the plane to carry 4,000-pound block busters, increasing its total bomb load to more than 10 tons.

Modification centers used by all aircraft



The mount for this 155 mm. field giant is designed for speedy transport

manufacturers play a major role in speeding new designs to the fronts. When word from Africa, for example, gets back that a front landing gear on a certain bomber is causing too many crackups or that a fine filter is needed to keep out sand, the improved landing gear and filter are added to the planes at special modification centers until the changes can be incorporated in the production lines at the home plant.

When a flier reported that our planes

On maneuvers with M-3 tanks in northern Ireland, U. S. tank crews were quick to point out any weaknesses





Army Air Forces photo

Parachute bombing gives low-flying planes chance to make safe getaway

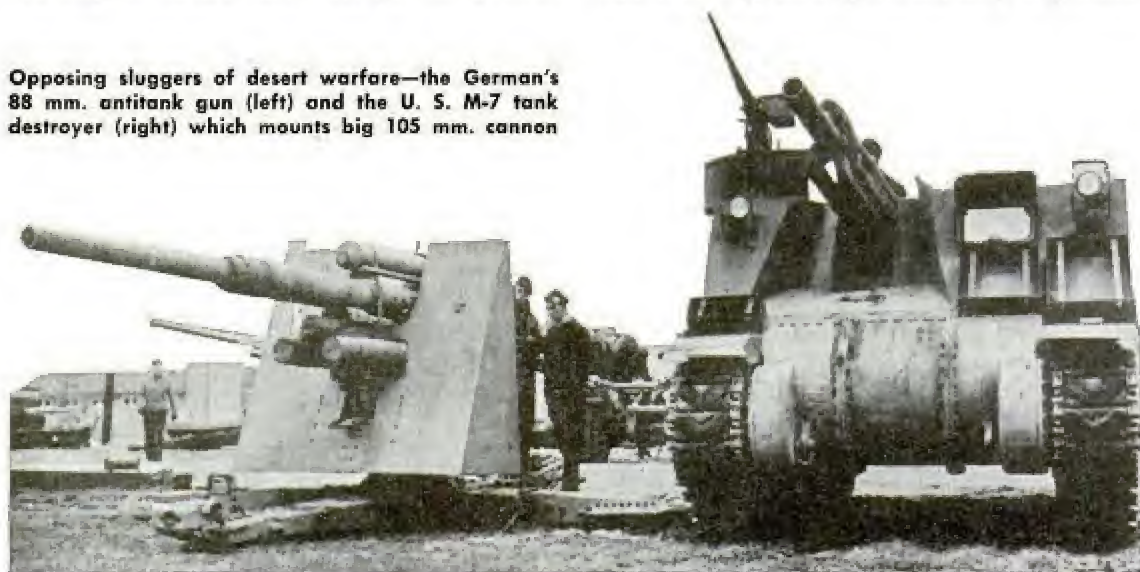
with the usual camouflage or olive drab stood out like beacons against the desert sand, the North American B-25 Mitchells were painted a dusty pink. A pilot complains that a metal control he must handle at high altitudes numbs his fingers. A rubber covering is substituted at a modification center in a matter of weeks instead of waiting to make the change on a new

model. A control is moved a couple of inches because a gunner skinned a knuckle in combat. A minor matter? Indeed not. No lesson in design, however slight, learned in combat is considered minor.

A flier grumbles that he can't tell when an engine is on fire until it bursts into flame. The prompt answer is a flame detector that warns the pilot. He immediately pulls a handle which releases a cloud of carbon dioxide gas to smother the flame. This gas answered another need when pilots reported that life rafts must be inflated in a few seconds when they make a crash landing on the ocean. These rafts are built to inflate in three seconds. Other combat-inspired equipment includes a "chair-chute" which drops the pilot out of a plane at the touch of a lever, a cabin top that is blown off by a charge of explosive (this one is German) to release the pilot.

A low-flying bomber crew that couldn't get away fast enough after dropping its "eggs" inspired the parachute bombs. They were first used on the Japs at Soputa, Lt. Gen. Henry H. Arnold recently revealed, with devastating effect. These terrifying bombs were dropped with pinpoint accuracy from 75 feet and the bombers had time to get away before they exploded.

Opposing sluggers of desert warfare—the German's 88 mm. antitank gun (left) and the U. S. M-7 tank destroyer (right) which mounts big 105 mm. cannon



N-218

Life Raft Radio Grinds Out SOS At the Turn of a Crank

The M-4 tank and the M-7 tank destroyer were virtually designed on the battle field. While tank crews liked the M-3 and considered it a vast improvement over earlier models, they lost no time in pointing out its weak points. These included the low side-placement of the 75-mm. gun. In the M-4 this gun was raised to the turret in the center and can fire in any direction. The crews also complained that the M-3 was too high, making too convenient a target, and that its vertical lines did not deflect bullets. That's why the M-4 is low and more contoured.

The consensus of desert tank crews was "you can't beat tanks with tanks." The result was a tank destroyer consisting of a 75-mm. gun mounted on a speedy half track vehicle. This was all right for hit-and-run tactics, but officers in the field reported that you can't conduct offensive warfare with this method. They wanted something with the wallop of a 105 and the agility of a jeep.

They almost got what they asked for in the U. S. "secret weapon" heralded as a tank killer. It was created by the marriage of a 105-mm. howitzer and an M-3 chassis and is the M-7. It was used to blow Rommel out of the desert and can rip through the armor of any known enemy tank. It can shatter objectives seven miles away and speed along at 35 miles an hour.

In their panic to find something to counteract the tank killer, the Germans in defending the Tunis-Bizerte region mounted 88-mm. guns on giant 52-ton tanks which lacked speed and maneuverability. Another unpleasant surprise for the Axis is the Army's new 60-ton tank.

Thus the school of design for war weapons carries on with ears glued to the theaters of war. It's hardly an exaggeration to say that for every plane, tank, tank destroyer and gun in operation there is a successor being designed incorporating lessons learned in combat. And the fighter pilot eight miles above the battlefield may not be scratching at the frosted windshield much longer. From the laboratories of American aviation comes word that gremlins who paint ice crystals in front of the pilot's eyes are about licked.



St. Francis - Philadelphia

Box kite serves as aerial for automatic radio that sends out distress signal from life raft which will support two fliers

Pilots of the Air Transport Command need not know the Morse code to send out a distress signal in the event they are forced down at sea, because the command's lifesaving equipment includes a two-man life raft with an automatic radio that sounds an SOS when the crank fixed to it is turned, thus providing means of rescue. The raft is also fitted with oars, a box kite to carry the sending set's aerial, and necklace type life belts.

Germans Drop Anti-Personnel Bombs That Explode at Slight Touch

N-2111



Showers of anti-personnel bombs, likely to explode on the slightest touch, have been dropped on England from Nazi planes. Weighing about four pounds, the bomb is painted either grayish-green or bright yellow. Its most noteworthy feature is a short, thick wire protruding from one side of the casing. The outer casing itself expands, when opened, into four hinged parts at the end of the wire.

*Capt. Allen Warren Elliott
7 Park Ave.
N. Y. C.*

*Capt. Alfred Coughley Edwards
2607 Grove Hill, Richmond, Va.*

5776

GUNNERS for the "GREENHOUSE"

"Twenty-seven enemy fighters were shot down," reads a communique, "and only one of our bombers failed to return." It wasn't an accident, either, that those enemy planes were blasted from the sky. Our aerial gunners—sharpshooters with a .30- or .50-caliber machine gun—are trained in a tough five-week course that includes everything from skeet shooting to drill in dive bomber



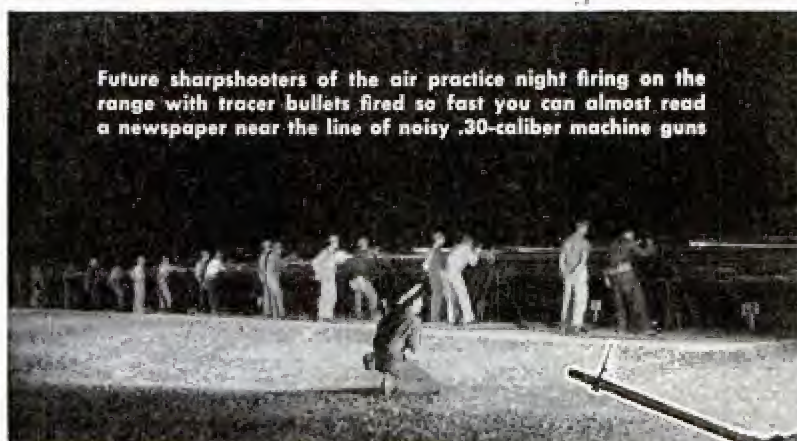
Above, sighting low-caliber, rapid fire gun. Left, shooting at clay pigeons with 12 gauge shotguns on mounts and geared to fire like machine-guns improves aim

Student gunner (below) operates sights on a Martin turret, trying to focus on a moving target. Gunner learns to shoot about 40 feet ahead



Army Air Forces photos

Left, firing machine guns at fixed targets that are first set up at 200 yards, then 500. Failing to hit target at 500 yards teaches gunner to wait for his quarry. Students include bombardiers and navigators



Future sharpshooters of the air practice night firing on the range with tracer bullets fired so fast you can almost read a newspaper near the line of noisy .30-caliber machine guns

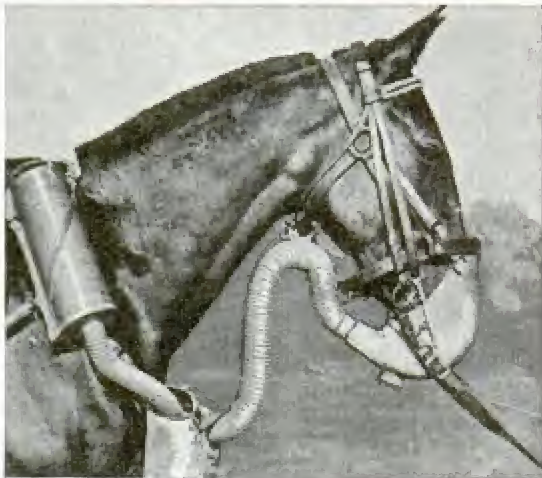
↑ Four-turret battery of .50-caliber machine guns blasts away at canvas target (not shown) towed by plane. This accustoms men to working in cramped space of real turret on a bomber and trains them to hit Messerschmitts, Zeros on the wing. Training turret is mounted on a light truck for quick transport on range

Right, with gun mounted on swivel, student learns how to move it and swing base mount. He is taught to keep elbows in, head down where he can keep sights in line

Near the Harlingen, Tex., gunnery school, students get aerial target firing (below) from plane over the Gulf of Mexico. Trained gunner becomes sergeant, gets wings



Gas Mask for Horse or Mule Weights Only 15 Pounds



Gas mask for mule is shown above, for horse, below

To keep army animals at work even in contaminated areas, chemical warfare experts have designed animal gas masks, weighing only 15 pounds, consisting of close-fitting muzzle pieces connected by flexible hose to canisters filled with material to purify the air. The mask for mules has two canisters, one on each side of the animal's shoulders, while the mask for cavalry horses has one canister on the horse's right shoulder, to balance the weight of the rifle carried on the left side.

Plane Spotter Can Stare at Sun With Lens That Kills Glare

Any plane spotter can look directly at the sun with clear vision while spotting hostile bombers with new optical lenses now in production. The development of this special lens, recently announced by the Bausch and Lomb Optical Company, is one of the many wartime optical discoveries—most of them guarded military secrets.

Another new glass being ground into lenses blots out all reflected glare, the company revealed, and a third, made without sand, has a higher refractive index than any glass known. The latter is designed for use in aerial cameras.

Spreader and Brace for Skis Keep Tips From Warping

Adjustable spreaders and braces for skis, claimed by manufacturers to prevent skis from warping, or to put warped skis back in shape, are made either of rust-resistant all-metal construction, with rubber cushions to prevent marring, or of wood-and-metal, especially recommended for commercial storage, cushioned with felt.



Steel Mesh Airplane Runways Form Base for 'Quickie' Road

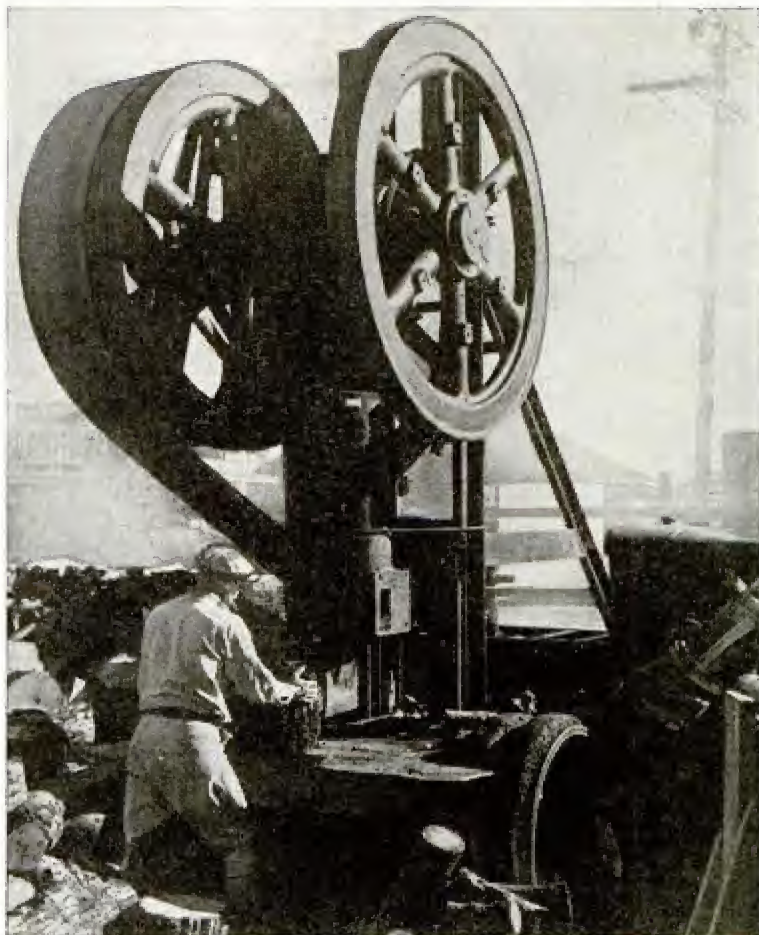
In war arenas Uncle Sam makes runways for the heaviest bombers by laying landing strips made of quickly assembled steel gratings, and the same technique is viewed as practical for laying a roadway, when steel gratings are again available for such purposes. A hard-surfaced dirt road might readily be laid by connecting the gratings, filling the meshes with sand, and oiling the surface for a binder.



Hammer and pronged tool lash road gratings together

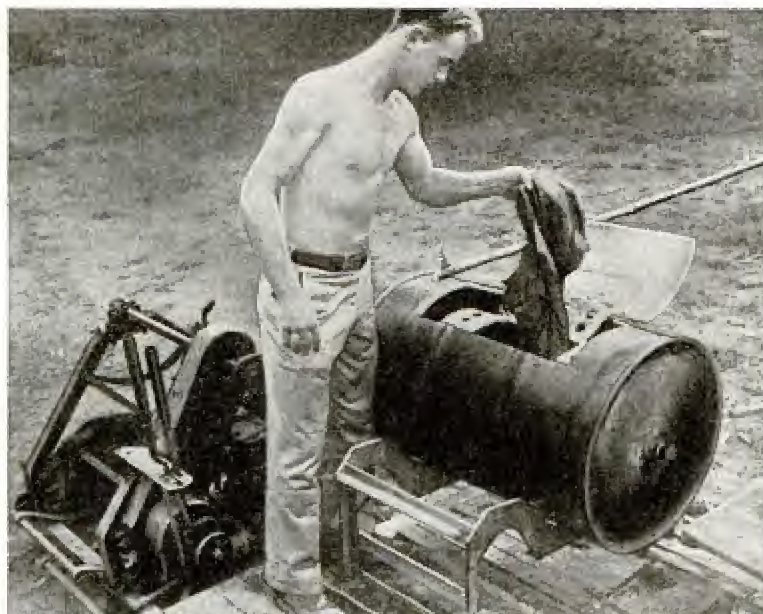
Mechanical Ax Driven by Automobile Motor 7-102

Fitted with a 12-inch ax blade fashioned from an inch-thick piece of steel, a mechanical wood chopper capable of splitting the toughest block of oak is powered by an automobile engine. Power from the motor turns a cam that drives a piston to move the ax up and down at the rate of five strokes a minute. It splits blocks up to 16 inches long lengthwise; longer blocks are laid on their sides. One man operating the mechanism steadily can split between five and six cords of wood in a day.



Twelve-inch ax blade
an inch thick is powered by an automobile engine to drive this mechanical ax, operating on a cam and piston principle. One man can split up to six cords of wood with it in a day.

Soldiers Make Washer From Fuel Drums and a Winch 7-103



Yankees fighting in New Guinea's swamps and jungles solved the problem of keeping clean by utilizing materials at hand to fashion a washing machine. Two old fuel drums, one small enough to be set inside the other, were fitted with hinged openings. The inner one provided the clothing receptacle, the outer one holding the water. With a motor-driven, wire-laying winch for power, the Yanks paid tribute to the axiom that cleanliness is next to godliness.

¶ An Italian locomotive is operated by methane gas compressed under 300 atmospheres, generating 120 horsepower.

Motor-driven wire-laying winch provides power for Yanks' New Guinea washing machine made from two fuel drums fitted with hinged openings

JULY, 1943

Pat. Wally Rathgeb
Wenatchee, Washington

Cont: Major Julian A. Spegall
2260 Far Hills Ave
Cleveland, Dayton, Ohio

71-108



The SKY'S NOT the LIMIT



Above, the Constellation—biggest, fastest land-based cargo airplane. Below, high-altitude crews are denitrogenized by 30 to 40 minutes of exercise while inhaling pure oxygen

"FIRST, we'll win the war; then, not even the sky's the limit on progress in aviation!"

That's how leaders of America's aircraft industry view the future. Without victory, no progress would be possible. Once victory is ours, virtually unlimited opportunities in the flying game will be open.

So vast are the possibilities, these men who know the inside story are hesitant to predict just what the postwar period will bring. They speak of aerial vehicles that not only will serve for personal transportation above the earth, but also may replace the automobile; they are agreed that American-operated passenger and freight air lines will girdle the globe; that the largest transport airplanes of today will be dwarfed by the ocean- and continent-spanning air liners of tomorrow; they point to the 2,000-horsepower engines now propelling Uncle Sam's mighty bombers and commercial craft as an indication of the bigger engines to come—3,000 horsepower very soon, 4,000 horsepower not

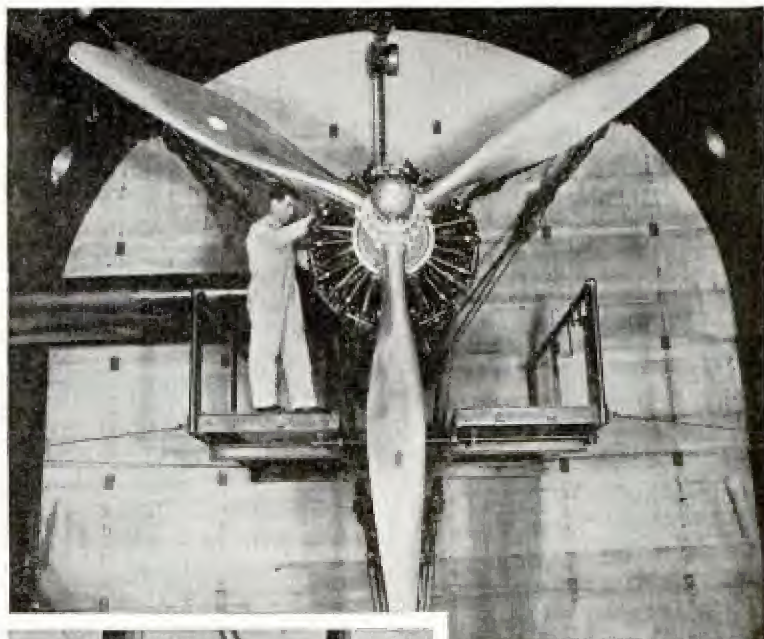
too far in the future—and they see passengers riding in comfort in the pressurized cabins of stratosphere-challenging airplanes at speeds that appear dizzy in comparison with those of today.

Many of these developments are in the making at this moment, they point out, being the ultimate result of research related to production of the world's best fighting and bombing and cargo airplanes.

E. E. Wilson, president of United Aircraft Corporation, producers of airplanes, engines and propellers, says:

"We live in the Flying Forties. A change in transportation would have come without the advent of war; however, war has accelerated the transition. We now see rapid development of air freight.

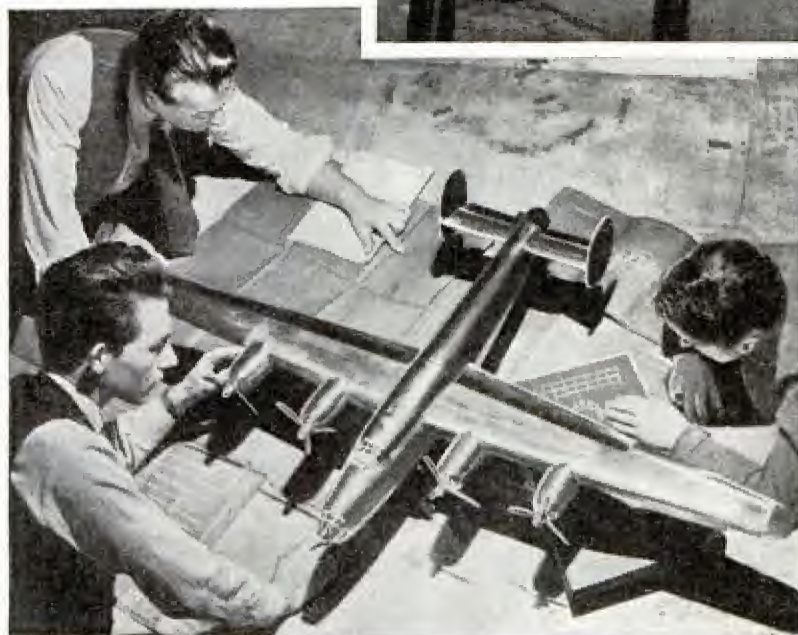
"At the end of the last war, many felt the airplane would then come into its own in private transport. This was premature. There was no airplane suited to this purpose; there were few airports and pilots. This will not be true at the close of this war, and it seems likely that new vehicles will be made avail-



Above, installing a new engine with giant three-blade propeller for a test. Left, a cell in the Hamilton Standard Propellers test house

ble. For example, Igor Sikorsky has perfected the helicopter. This is a rotating wing aircraft, capable of ascending and descending vertically, moving sideways, forward or backward and hovering under complete control. It can be built with the body of a small car. Its owner could use it as a business car, and as an airplane when distance warrants. We may see the end of the present automobile for personal transportation.

"With the wider use of the airplane for personal transportation will come a new industry accompanied by innumerable auxiliary services, such as those which surround the automotive industry. A completely new economy can be built around this new vehicle, providing in-



Production engineers study a model of a 4-engine bomber



Entering the Boeing "stratosphere chamber," the pilot zips an emergency oxygen bottle into the leg of his flight suit

creased employment and new national wealth.

"Financially, we in aviation seek to earn enough in wartime to protect investors, survive the transformation period and discharge a new responsibility to the public when the war is over. And what is this responsibility? It is to realize for America the tremendous opportunities that should

follow the conflict. Where Britannia ruled the waves, America should free the air. Just as the railroads pulled the nation out of the depression following the Civil War, and as the automobile sped it out of the depression following World War No. 1, so should the airplane lift us to new heights after this war."

Back in 1925, a dynamometer laboratory was built with a capacity for testing engines of 2,500 horsepower. It appeared ridiculous then, because no engine exceeded 600 horsepower. One scientist tried to prove by mathematics that an air-cooled engine never could be larger than 750 horsepower. Today, that dynamometer is too small to take care of engines under development.

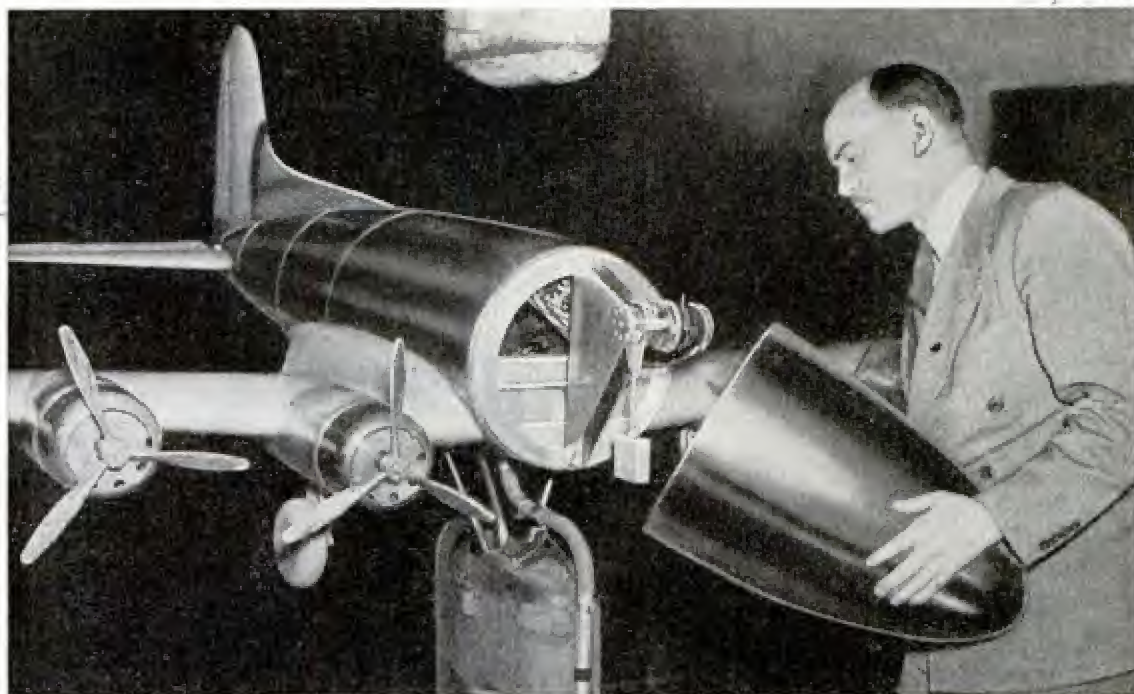
Now work has been under way for some time on a new dynamometer laboratory which can test engines of 8,000 horsepower up to 20,000 feet and 4,000 horsepower up to 40,000 feet. Another phase of future development is the multi-engine airplane. Tomorrow's air liner may be expected to have at least six engines; eight-engine airplanes are being considered.

On the postwar future, P. F. Johnson, president of Boeing Aircraft Company, has this to say:

"The air age will have to be built, not inherited. It will not come by the mystic dawning of a new era, but only by a concerted program of development of commercial and civilian aviation, which may

Fully equipped soldiers practice getting into quick action as they land from a transport plane





Installing the nose on a "Stratoliner" model prior to a wind-tunnel test of this high-altitude transport

take a number of years, and by the perfection of new aircraft designs and airways facilities that will make aviation of more direct service to more and more people throughout the world.

"The engineering developments that will help bring this about are already taking shape. Developments forced by war, many of them secret, will be converted for commercial use after the war to make flying safer and more practical.

"At the Boeing Company, for instance, the engineering force which created and developed the Flying Fortress, the Stratoliner and the largest Pan American Clippers has been enlarged until it now numbers not hundreds but thousands. Scores of engineering fields, electrical, hydraulic, acoustical, radio, refrigerating, architectural, metallurgical, structural, aerodynamic and many others are represented—a wealth of engineering talent to be one day unleashed on the job of making better products for a peacetime world.

"The opportunities for development of postwar aviation lie in several directions—passenger transportation, private flying,

first-class mail, air express and air freight. The development of these fields will have to come not merely from desire, but from economic justification. Air cargo, for instance, has competitive limitations where weight and bulk are concerned. On the other hand, there are extensive opportunities in many foreign countries that are under-developed because of lack of adequate transportation.

"The postwar opportunity will be that of making a war-developed industry serve to build a better, more united world."

For months, Boeing's "flying laboratory"

(Continued to page 154)



Trial of a complete wing section with engine on rack reveals performance before production starts

Louis Melnd Co.
West Chicago Ave
Chgo. Ill.

Sponge-Back Rubber Stamp Prints Around Corner

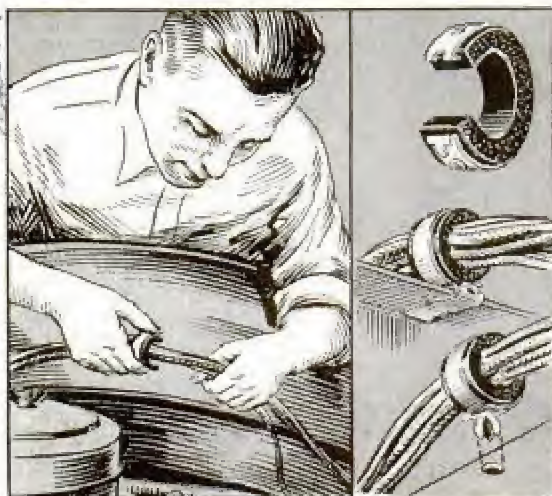


Stamp's flexible back permits printing around corner

Mounted on an airy cushion of sponge rubber, said to be so resilient that its action will not injure even fragile packages, a rubber stamp capable of "shooting around corners" is sufficiently flexible to print clear impressions on curved surfaces. Alternately, half the impression may be printed on one side of a container, and the other half on the adjoining side.

Snap-Clips for Wires or Cables Fasten Almost Anywhere

Wire harness clips to hold wires, bunches of wire or cables are lined with non-absorbent synthetic sponge rubber, or plastic insulation, which wedges around and between the wires and prevents chafing. The spring-steel clip itself is fitted in the

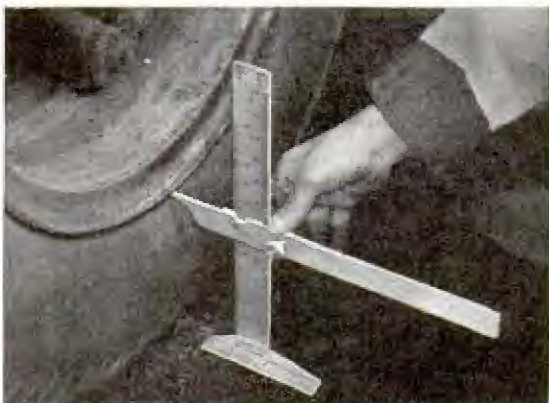


Wire harness attaches in place in a variety of ways

larger sizes with dovetailed hook-ends said to guarantee against accidental opening. A variety of fasteners on the back of the steel clip permit attachment of the clip and its burden of wire with rivets, rivet studs, snap-fasteners or spring clips, increasing the clip's versatility.

"Bulge Gauge" for Truck Tires Shows Air Pressure Needed

Truck drivers may determine whether or not their tires are properly inflated, no matter what the load on the truck, with a sliding rule called the "Deflect-O-Gauge." Tires are built to deflect 12.8 percent under capacity loading, for with that percent



Taking undeflected (top) and deflected tire reading

of deflection there is the least wear. With greater deflection the tire spreads and the fabric sidewall ultimately breaks down. With an underload and less deflection, a small portion of the tread gets abnormal wear. The gauge shows exactly how much air is needed to give the tires the proper percent of deflection, whether underload or overload exists.

You can obtain additional information about products described in this magazine by writing to the firms listed in the Where-to-Buy-It index. Say You Saw It in Popular Mechanics.

FIGHTING *the* PIGBOATS



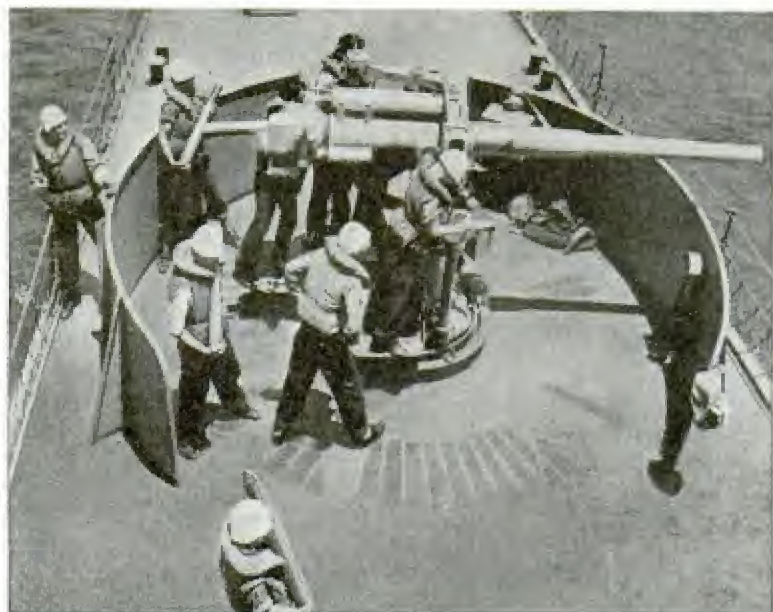
UNRESTRICTED submarine warfare has been declared by the Axis and this threat to the Allies' chances of victory is so serious that America's scientists have been called upon to redouble their efforts to produce weapons for combating the "wolves of the sea."

Important results already have been achieved in the anti-submarine campaign. Some of the weapons must be kept secret for they provide the means by which many a submarine makes only a one-way trip from its German base, creating a state of anxiety among those awaiting the return of its crew. This very element of mystery helped the Allies win their fight against the submarine in the World War, for German crews finally refused to man the undersea craft on voyages from which there was no returning, nor even word of the U-boats' fate.

But there are other developments. From Britain comes word of a radio "magic eye" which enables an air or surface observer to spot a submarine when it comes to the surface to

Mortal enemy of the submarine is the depth charge, shown flowering into explosion below. PT boat, above, may carry such "ashcans"





Should a U-boat, attempting to conserve torpedoes, surface and fight it out with its deck gun, Navy gun crews would give the sub a hot reception

recharge its batteries, even on the darkest night. London also reports a new type of escort vessel, an outgrowth of the corvette, which is said to be the most heavily armed ship of its size in the world. Rapid production, more rapid than that of destroyers, is a feature of this weapon, for it means more surface craft to combat the dread U-boats.

Here in America, research on anti-submarine devices goes on feverishly, together with a tremendous building program to produce deadly escort vessels by the score. In addition, there is a constant stepping up of the anti-submarine air patrol, by scout planes, long-range bombers and lighter-than-air craft—the blimps. The day is not too distant when no convoy will be without air protection at any point in its journey across the Atlantic.

That list of escort vessels includes, of course, the principal weapon against the submarine—the destroyer. More than one

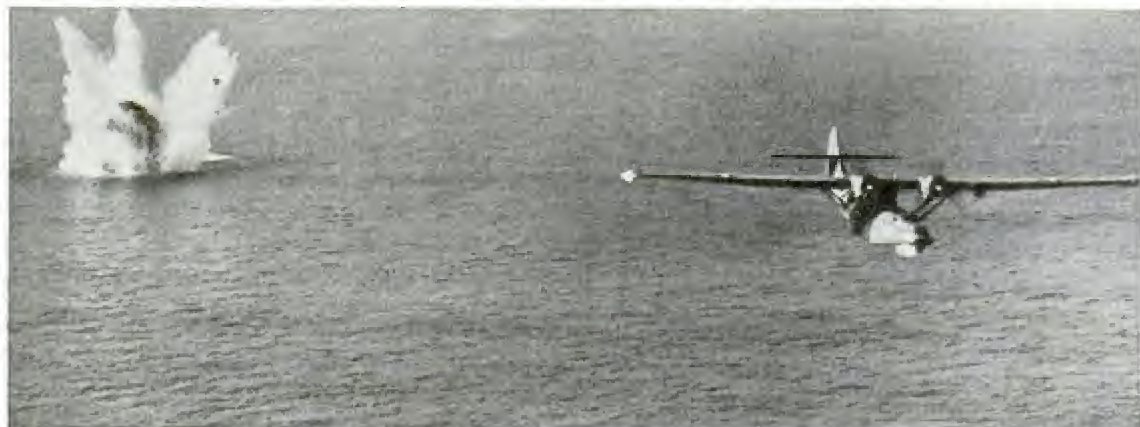
naval authority has expressed the opinion that “the more destroyers, the fewer submarines.”

Depth charges, hurled from surface craft, and bombs, dropped from air-planes and blimps, apparently are the most effective anti-submarine weapons yet devised. Bombing planes can search rapidly over a vast area of sea and, especially in smooth water, can spot the underwater shadow of a submarine more readily than can a vessel on the surface. The aircraft do not need to fly at great altitude; they are deadly when they drop their bombs.

Destroyers, sub chasers, corvettes and other surface vessels, while not so speedy as the bomber, have superior gunpower and greater volume of depth charges. These charges are ejected from gunlike throwers which make it possible to cover a considerable area of the sea with a pattern of destruction. The ejectors work on a swivel so that the charge may be directed to any selected spot.

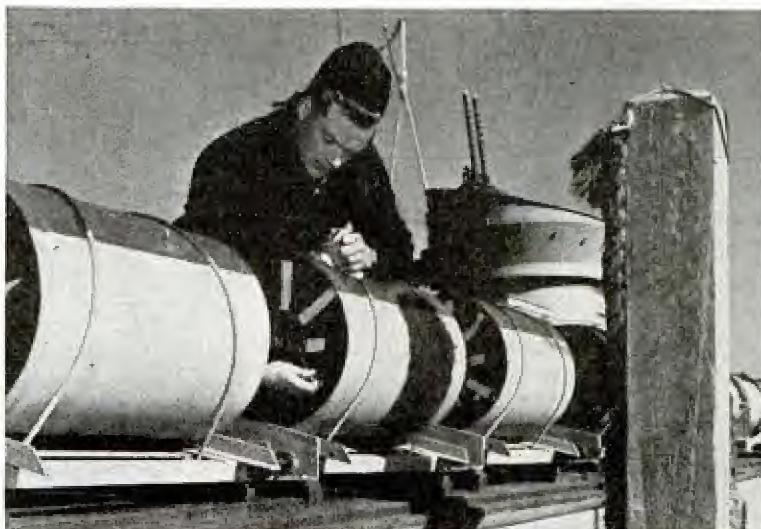
But it's a big job—this beating the submarine—the biggest job that any combination of seapower has ever had to face. True it is that the Allies defeated the Kaiser's submarines back in 1917, but today the problem is far greater. At the peak of Germany's World War U-boat strength, the Kaiser mustered fewer than 150 under-sea vessels, many of extremely limited range; now Hitler has an estimated 400 submarines, most of which can rove the seas thousands of miles from their bases. And dozens of shipyards and engineering

Long-range flying boats, carrying depth bombs, can patrol wide areas and may spot sub by its shadow

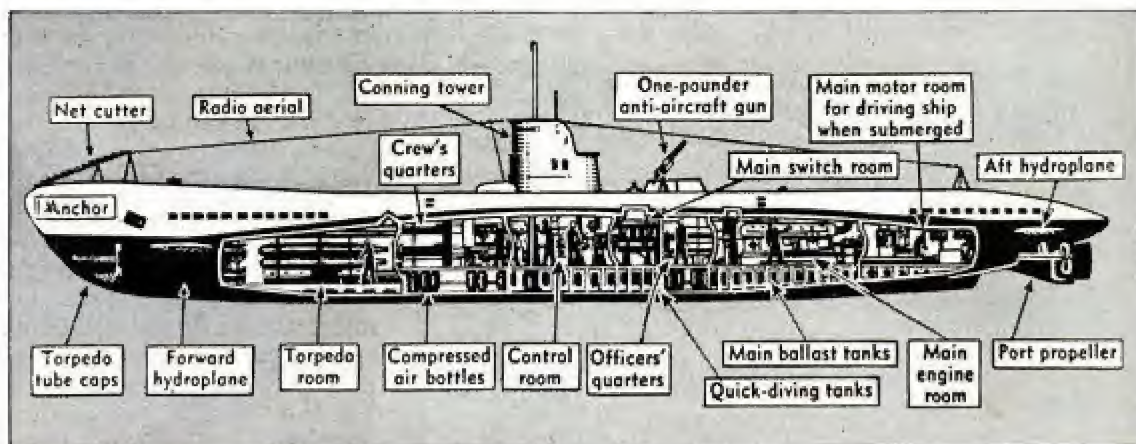


plants in Europe are working around the clock to produce submarines faster than the Allies can sink them.

The modern German submarine, many times more powerful than any turned out in the World War, frequently can make port after its conning tower has been shot away. It is constructed with a double hull, with oil compartments placed between the two hulls to absorb the shock of depth charges except at very close range. And that's why a patch of oil on the surface after a depth charge has exploded can



PT boat's "ashcans" may be set to explode at pre-determined depths, to assure maximum force of concussion is exerted close to submarine



no longer be accepted as evidence that the submarine has been destroyed.

More than 220 feet long, with a 20-foot beam and a submerged displacement of nearly 900 tons, the German U-boat carries 12 deadly torpedoes and a quick-firing bow gun of more than four-inch caliber to pick off lone ships and thus conserve torpedoes. It is driven by 2,800-horsepower Diesel engines that give a surface cruising speed of 17 knots; in an emergency, this can be pushed up to 20 knots.

Range of this undersea raider is so great as to be amazing to the layman. Serviced occasionally by surface "mother" craft, it

Both hunter and hunted is the Nazi pigboat, shown in cutaway diagram above. Below is its traditional enemy, a knife-prowed U. S. destroyer





Coast Guard "sub-buster," ferret of the convoy lanes, is armed to the teeth against Nazi wolf pack

miral Karl Doenitz, with instructions that it was to be used with utter ruthlessness. That it is a deadly weapon can be deduced from the toll taken of United Nations shipping since Pearl Harbor—between 600 and 700 vessels sunk along the Atlantic coast of the United States, literally right in our own front yard.

That Hitler's latest move is an all-out effort to win the battle of the Atlantic is recognized by United Nations' military strategists. Already the submarine wolf packs are becoming larger; Secretary of the Navy Frank Knox stated recently that there were more U-boats in the Atlantic than ever before and he added:

"We have a tough period ahead of us in the Atlantic. The operations in North Africa have tremendously increased the Navy's task. With the convergence of convoy routes at the western end of the Mediterranean, the targets are multiplied in the very front yard of the German submarines and airplanes. We know they have a very large and growing U-boat fleet in the Atlantic and



Ship's plates crumpled like paper show destructive power of torpedo (left)—but this one made port. Below, sketch shows how Nazi submarines plant mines

can remain away from its base for many months. Now come reports that Germany is using a fueling vessel which can be submerged slightly, thus being made invisible to all except aerial observers. This submersible tanker is towed by surface vessel or submarine to a rendezvous, there to remain until its fuel supply is exhausted.

This, then is the powerful weapon that Hitler recently handed to Ad-



more in training in the Baltic. We have made a good start in Africa. We may have to pay a price for it, and we would do well to prepare ourselves for losses at sea from submarine attacks in the next four or five months."

Thus, United Nations leaders are well aware of the critical aspects of the situation. They know that if Britain is to live and fight, a minimum of 800 ship crossings of the Atlantic must be made safely each month. They know, too, that if the submarine becomes effective enough, American supply lines to North Africa can be disrupted and Allied efforts in that area can be paralyzed; further, that if these supply lines cannot operate effectively, there will be no early invasion of Europe. Since they have pledged all resources to an invasion effort, it is obvious that they are betting on American and Allied scientists to produce the answer to the undersea terror.

The picture is not entirely black, although far from bright. Prime Minister Winston Churchill, addressing the British parliament, said recently:

"Progress is being made. We have hardly any losses in our heavily escorted troop convoys, and out of about three million souls who have been moved under protection of the British navy, only 1,348 have been killed or drowned, including missing.

"The rate of killings of U-boats has improved steadily. From January to October, 1942, a period of 10 months, the rate of sinkings, certain and probable, was the best we have seen so far in this war. But from November to this date (early in 1943), the rate has improved more than half as much again.

"At the same time the destructive power of the U-boat has undergone steady diminution. In the first year of the war the operational U-boat accounted for an average of 19 ships; in the third year, but seven and one-half. It is because of this that the U-boat warfare takes first place in our thoughts."

Despite this somewhat optimistic view, the prime minister recognizes the great peril, for he warned:

"The losses we suffer at sea are very heavy and they hamper us and delay our operations and thus prolong the war."

And that is why the United Nations leaders have given the task of overcoming the submarine first priority in their plans.

For the promised invasion of Europe millions of tons of shipping will be required and this shipping must be protected.

The United Nations MUST beat the submarine to win the war. Our military observers agree that the fight will be extremely difficult, but that it can and will be won.

JULY, 1943

*Air Services
17 C. 42nd St.
N.Y.C.*

Heat Baffle for Oil Furnace Lowers Fuel Consumption



Inserting heat-saving unit that fits most furnaces

Readily installed by simply placing it on top of the existing combustion chamber, an inexpensive refractory heat baffle, said to effect substantial savings in fuel oil, fits round or square furnaces, either with the horizontal gun type or rotary oil burners. The baffle, requiring the cutting down of the oil feed, causes the fuel to burn more completely, also producing a "scrubbing" action against the side of the furnace, to deflect heat against the furnace surfaces and hold it longer in the flue passages.

Carrot Diet for Oxygen Hunger May Aid High-Altitude Pilot

Combat fliers at high altitudes may be able to withstand lack of oxygen by turning to a diet of fresh carrots, experiments at Northwestern University Medical School indicate. Doctors there kept a group of rats for 10 days on a diet of nothing but carrots and tap water, then put them in a low-pressure chamber simulating atmospheric conditions at altitudes of 30,000 feet for two hours. Of 107 carrot-fed rats, 85 survived the lack of oxygen, whereas only 23 of 107 rats on a normal diet survived. Experiments are continuing to ascertain what carrots contain that provides apparent protective effect against oxygen lack.

*L. Nelson, S. Galtich & Co. Inc.
Northwestern University Medical School*

Cont: Allen Warren & Co.
7 East Avenue
N. Y. N. Y.

701-1158

ART DETECTIVES



Portrait at left above was in such bad condition it sold for only \$300, but when restored by art detective, as shown below, it will be worth \$5,000. Partially restored face is shown at right above



IN WAR, rare and beautiful works of art become virtual pieces of international currency which can be passed, by selling them, in practically any country in the world. This is particularly true of paintings by recognized masters.

Valuable paintings have advantages over ordinary currency because most countries are exercising rigid controls over the movement of cash across their borders, and because works of art can be used as protection against currency inflation.

Bombing of big cities has made rare art all the more rare. And a painting is portable, so that a man can walk off a ship with a million dollars worth under his arms, yet Uncle Sam charges no custom duties—as he would on diamonds—if the object of art is over 100 years old.

One result of these wartime circumstances is that the United States is being flooded with millions of dollars worth of art carried by rich refugees. Most of them have to sell their masterpieces.

Unfortunately for many,

POPULAR MECHANICS

Picture: Sheldon Cook - Brooklyn Museum
Eastern Parkway
Brooklyn, N. Y.

X-ray of this 15th century Madonna showed it had been repainted often. The position of child's arm had been changed

counterfeits are far more common in this kind of currency than they are in greenbacks.

So the war has increased the importance of the small group of scientists, particularly in museums, who have for years been building up fool-proof systems of uncovering fraud in art.

Recently a dealer walked into the Brooklyn Museum with a painting he had sold for \$85,000, but had not delivered because of honest doubts about it. A few days later he was \$85,000 poorer because it was not the product of a famous old master as he had supposed.

The same art detective who worked on this case, Sheldon Keck, restorer for the Brooklyn Museum, was recently handed a landscape reputedly by the Dutch artist Meyndert Hobbema of the 1600's, and worth \$12,000.

Inspection caused Keck to suspect that the tiny cracks which are a sign of antiquity on a painting, had been applied with a brush. A microphotograph increased his suspicions. Dipping a wad of cotton in some chemicals, he wiped a spot and the "aged" surface, pigmented varnish, rubbed off leaving bright, fresh paint, the sign of the counterfeit. To cinch the case, enlarged photographs of the "worm holes" in the wood frame proved they had been made by nails. Worms do not leave rounded edges on the holes; nails do.

Another case, in which the forgery was not deliberate, involved a Madonna by an Italian master. Keck put this work under X-rays, and the plate showed the painting had been done over so many times it could hardly be called the work of the original artist. One retoucher even moved the arm of the child Jesus from its original position.

These cases of counterfeit "art currency" can be multiplied by hundreds from the files of museums and art dealers. It is a standing joke among connoisseurs that of

Wooden art pieces often are honeycombed by termites which museums combat by placing object in a glass case and fumigating with carbon tetrachloride





Before-and-after of a restoring job is shown above. Ikon at right originally looked like worthless piece at left because eight layers of paint covered it. Strata of paint are shown enlarged →

the 3,000 pictures painted by Corot "at least 10,000 are in the United States." This country is the dumping ground for European art forgers.

But another side of the art detective's work is illustrated occasionally by true stories of people who have paid as little as \$50 for genuine masterpieces.

The Brooklyn Museum recently picked up a portrait of Deborah Hall painted by the famous American artist William Williams in 1766. It was so cracked and chipped the owner was glad to get \$300 for it. After putting it through laboratory tests, Keck cleaned it thoroughly, applied a filling of gesso—whiting and gelatine—pressed the paint carefully and the owner would never have recognized the painting. Next he began retouching. When the job is finished, the value will range between \$4,000 and \$5,000. Each spot is painted over three times with pigment in a varnish medium, each coat being made a little darker until the correct tone has been achieved.



Another time Keck gave the museum a surprise in the form of a \$15,000 painting of Saint Joseph by Jusepe de Ribera. The painting was in de Ribera's style, but presumed to be the work of a pupil and worth probably \$400, until Keck, applying X-rays, ultraviolet light and chemicals, uncovered the signature of the great artist. European artists had repainted and covered the signature, thus defrauding themselves.

Keck also tells of a Russian ikon, or religious painting, of Saint Nicholas, on wood, which had become so battered since it was painted in the 1500's that it was practically junk.

Keck began working with a microsectioner, much like a hypodermic needle with the end sawed off. Jabbing it through the paint film in an inconspicuous spot, he brought out a tiny cross-section of paint. A push of the plunger ejected the sample. This was photographed under a high-powered microscope. When the photograph had been enlarged 100 times, Keck discovered the real picture under eight layers of paint and varnish, a truly beautiful work of art with a genuine gold

The ultraviolet lamp (below) detects new paint covering the old



background. By tedious work he removed one layer after another until the original, now worth at least \$1,000, was restored to its natural glory.

The art detective has built up a specialized kit of tools. The ultra-violet lamp will often reveal retouching of old masters. Varnish fluoresces. Repaintings do not as a rule. Often a fake signature will stand out in glaring contrast to the rest of the picture. Added brushwork to imitate the style of a master is thrown into bold relief.

What the eye does not reveal, the camera lens sometimes will. An ordinary camera may be used, with a yellow filter and exposures ranging to half an hour.

The X-ray determines the condition of paintings below the surface just as ultraviolet does on the surface. Photomicrography permits huge enlargements of small details of a painting to compare distinctive brushwork. The microscope's especial use is for making microchemical analyses of pigments or examining cross-sections of paint removed by the microsectioner.

There is a vast difference between the practices and points of view of the modern restorer and the work of the restorer of past centuries, says Keck.

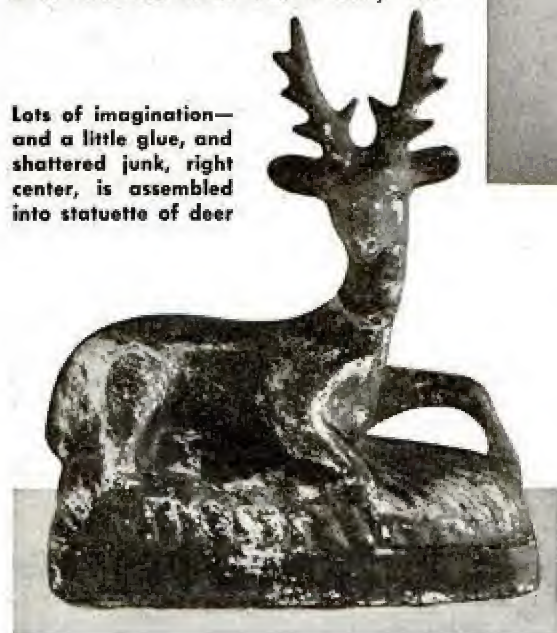
"Having determined exactly the state of the picture, the modern restorer's first task may be to transfer the layers of paint from a rotten canvas to a new one," ex-



Ancient sculpture often is found in pieces, and art detective must reassemble them. Above, repairing damaged base of statue



Lots of imagination—and a little glue, and shattered junk, right center, is assembled into statuette of deer



plains Keck. "He will be obliged to clean the surface of old varnish and dirt, using solvents and methods that will remove the dirt and varnish only and not destroy the surface. He may also remove paint previously applied in an effort at restoration.

"Sometimes he finds two paintings, one over the other, and has the delicate task of separating the paint layers and preserving both. He has also to fasten to the new support bits of paint that were cracked and loose. Sometimes an entire painting is a picture puzzle of such cracked fragments.

"When parts of the paint are missing, he

(Continued to page 148)

*Lemard Engineering Co.
Steele Springs O.O. Capital View
M.D.*

11-80

Sliding Magnifier on Ruler Has Unbreakable Lens



Plastic magnifying lens assures accurate scale reading

Accurate readings of measures down to one-sixty-fourth of an inch are claimed for a scale, mounting a detachable magnifying lens, intended for use in checking the length of parts, depth of holes, center distances in layouts, finishes of metals and the like. The lens, made of a patented, unbreakable plastic, is mounted on a post screwed into a slide block that glides along a standard machinist's six-inch rule. Demounted, the whole apparatus lies flat in the pocket.

Lenses of "Armorplate" Glasses Withstand a Direct Blow

Industry is protecting the eyesight of its workers with an unbreakable eye-glass, nicknamed "armorplate," that can withstand a sledge-hammer blow without

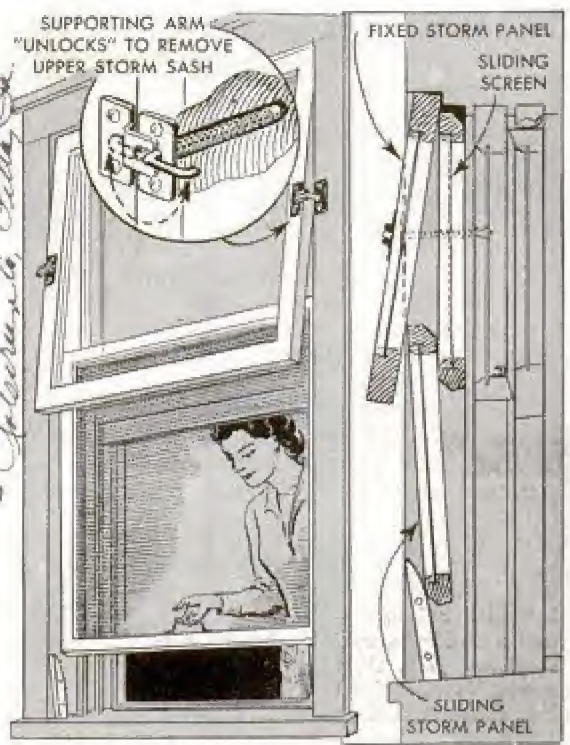


Women give the lens a dramatic if humorous test

cracking. The lenses, for all their strength, are neither thicker nor heavier than ordinary lenses, and can be ground as accurately. Their toughness is said to come from a special annealing process. Hammer and mallet blows do not even scratch the glass; pressed in an iron clamp, they still neither break nor crack. In one humorous test, in fact, it was demonstrated that a fist blow would harm neither the lens nor the stricken person's eye.

Permanent Storm Sash, Screen "Stored" Right in Window

Drilling two holes and setting four screws per unit is all that is required to install a combination storm sash and screen which remains in place the year around. Behind a permanent storm panel that angles out from the window on a spring-held supporting arm, the screen is "stored" in winter and the lower storm panel stored



Screen or storm panel is lifted behind permanent sash

in summer. Tension of the spring is also said to hold the unit tightly and eliminate rattle from the wind and vibration noises from traffic. Entire operation is from inside the house.

Names and addresses of makers or sellers of commercial products described in this magazine are listed in the Where-to-Buy-It index. Write to them for additional information and be sure to Say You Saw It in Popular Mechanics.

*American Optical Co.
10 S. Wacker
Chicago, Ill.*

11-223

4-243 *Sentry J. Kaiser*
Wescor, Inc.
Mockup of Radio Office in Bomber Trains Men *Pub. Works*
Wescor, Inc.
4000
Wescor, Inc.

With complete liaison radio sets, plywood replicas of the radio operator's section of a Flying Fortress are used to introduce students to "combat" by the Army Air Forces Technical Training Command at Scott Field, Ill. Before "taking off," the student radio operator receives a "briefing" which includes his route guide for the "bombing mission," code cards and other special instructions.



Clad in fur-lined flying suits, radio students at Scott Field (above) make contact with ground units while "fly-in" in mockup which simulates conditions on bomber flight to Berlin. Left, entering mockup

Clad in a fur-lined flying suit, he enters the mockup and makes the proper pre-flight inspection. During "flight" he is called to contact various ground stations for information and a complete log of operations must be kept. Induced static, temperature control that gives the compartment a high altitude chill, and a mounting

for the mockup that permits it to be rocked in all directions help to make operations realistic. Also, when the interphone warns of an enemy fighter closing in, the student seizes a dummy machine gun. Like regular bomber crews, the students give their mockups fanciful names like "Zombie" and "Berlin Valentine."

4-180
Dual-Purpose Aircraft Carrier Is Also Plane Transport



President Roosevelt views model of Kaiser's dual-purpose aircraft carrier

Scheduled to be delivered at the rate of six a month by the end of this year is a new American contribution to air-sea warfare, a dual-purpose aircraft carrier designed also to serve as an air-plane transport. Henry J. Kaiser, producing the vessels in a 12-way yard in the Northwest, presented a model of the craft to President Roosevelt on a visit to the White House.

JULY, 1943

Public Relations Section
AFF Detachment Training Command
Scott Field, Ill.

MOSQUITO BLITZ



Unhatched mosquitoes by the billion are killed with boat spray that shoots three 65-foot fountains of larvicide

Mosquito-fighting crew uses "Swamp-Angel," four-wheel-drive truck with oversized tires for navigating marsh

Photo courtesy Saturday Evening Post

YOU'VE heard of pink elephants and purple cows, but the chances are you have never heard of blue, red, green and purple mosquitoes.

Any bugologist will tell you there "ain't no such animal." Residents of the mosquito-conscious Des Plaines River Valley 10 miles west of Chicago will testify there are millions of colored mosquitoes. What's more, they will prove it by leading you to the man who stains them, known as the "skeeter painter" of Lyons, Ill. He is J. Lyell Clarke, sanitary engineer for the Des Plaines Valley Mosquito Abatement District.

The worn path to the door of his one-story brick building near the banks of the Des Plaines is proof of the old saw about the man who made a good mouse trap. Mosquito control workers and



8130 Ogden Ave., Lyons, Ill.

*Red Spahrwitz
Maywood, Ill.*

health officers from all over the nation, from Hawaii and South America have stopped there.

They don't come to learn how he stained some 31,000,000 mosquitoes in a single experiment. That is just part of the picture. What attracts them is the fact that his work has reduced woodland and domestic mosquitoes in the district by 90 percent and the vicious floodwater mosquito by 60 percent. Anyone who has ever swatted a hungry mosquito can appreciate those figures. Before Mr. Clarke started his abatement project it was not uncommon in a "bad season" for the residents of the valley to find from 20 to 200 of the domestic variety in their bedrooms despite careful screening.

His method of fighting mosquitoes is a combination of prevention and blitzkrieg. A mechanized "panzer division" sweeps through the valley with specially designed machines affectionately named Puddle Jumper, Swamp Angel, Dinosaur, Skeeter-Eater and Corner Cutter.

"Fighting mosquitoes is like fighting fire," he says. "You have to work fast when they are hatching or you lose control. We designed our equipment for speed. The Puddle Jumper, Swamp Angel, Dinosaur and Skeeter-Eater are large-tired four-wheel-drive



Photos courtesy
Saturday Evening Post

Above, spraying catch basin with a "Corner Cutter" — motorcycle with a spray unit in side car—saves time



Novel mosquito trap (left) attracts insects by light that turns on automatically at 7 o'clock every evening

Below, spraying larvae in swamp. Man with dipper takes a count to estimate the hatch and note variety





"Painting" breeding ground with colored dust to check mosquito range

units—we also call them marsh buggies—that get around in a hurry through marsh or swamp. High pressure sprays are mounted on these buggies. The Corner Cutter is a motorcycle with a spray unit in a side car used for spraying catch basins."

The Corner Cutter will spray 450 closed catch basins or 600 open ones in a day. A boat sprayer that shoots three streams of larvicide about 65 feet is used on the Des Plaines River. When the abatement program was getting under way back in 1928 it took 40 men a week to spray the river. Now five men can do the job in a day. Pyrethrum larvicide and a new substitute, lethane, are used for spraying fresh water. They do not harm fish or plants. Fuel oil is used only on polluted water.

A new form of war on mosquitoes, recommended by Mr. Clarke and now being used by the army, is a gas bomb that contains pyrethrum. A small bomb set in a barracks or on your front lawn spurts like a fountain and kills mosquitoes for yards

around. The army's only difficulty in making the "mosquito bomb" is that pyrethrum is hard to get for it is made from a plant that flourishes only in Japan and Kenya Colony, Africa.

After a heavy rain, Mr. Clarke's staff works virtually night and day "blitzing" the possible breeding places in the 76 square miles of the district. They have a seven-day deadline, for by that time the eggs in the floodwaters will have hatched and the mosquito developed through the larva and pupa stages into a winged insect. The flood-

water mosquito, the most difficult to control, lays its eggs in marsh grasses that will be flooded. About 15 percent of the eggs are hatched during the season they are laid. Most other mosquitoes lay their eggs on water in little rafts that hold about 200.

Water is the staff of life to mosquitoes. They can't live long without it. Kept in a cage where water is inaccessible they die within six days.

There are three favorite breeding places on or near home premises: fish pools, excavations of unfinished buildings and rain barrels. Buckets, tin cans, tubs, drums, bird baths and sprinkling cans also serve as hatcheries. If your bird bath is in the sun and in frequent use, the chances are mosquitoes will avoid it. If they do lay eggs there they will most likely be broken before they can hatch.

For the fish or lily pool owner who has a feeling of guilt in the mosquito season, Mr. Clarke has only a kind word. Controlled pools are mosquito traps, not hatch-

Seining surface minnows for distribution to lily pools in back yards—minnows thrive on mosquito larvae



eries, he says. A few fish, especially surface minnows (*Gambusia affinis*), a plant (bladderwort) that devours larvae in little suction cups, and aquatic insects will transform any pool into an excellent trap.

The domestic mosquito that hatches on home premises and vacant lots has been brought under control in the Des Plaines district by house-to-house inspection and education of the public. This mosquito, which has a short two-mile flight range, is the type that comes into homes at night. When a complaint is received, field men search the vicinity for a breeding place and usually find it.

Two other general classifications of the 32 species of mosquito studied in the district, aside from the domestic, are the woodland and floodwater varieties. Mr. Clarke compares the domestic, woodland and floodwater mosquitoes to the chicken, wild turkey and wild duck, respectively. The woodland mosquito that hatches in spring and early summer never leaves the woods, often ignoring a juicy golfer 50 feet away; the floodwater type ranges far afield but will not come indoors, and the domestic prefers an indoor *a la carte*.

The fresh-water swamp mosquito is used in staining experiments. The hatch of one swamp is dyed blue, another purple, another green, red, brown or yellow. Mr. Clarke was unable to stain mosquitoes by the million until he discovered by accident that they could be dyed with dust instead of liquid. While mixing powdered red dye near a cage of green mosquitoes one day he discovered that dust particles had settled on the green insects giving them a red polka-dot effect. (There's one for the entomologists!) Now a finely ground commercial aniline dye is mixed with flour and dusted over marsh grass containing newly-hatched mosquitoes.

Scattered through the district are 30 testing stations. Mechanical traps equipped with light bulb, suction fan and "poison jar" are used to make the catch. The traps operate automatically from dusk to dawn every night. Staining experiments ended long-standing arguments about the flight habits of floodwater mosquitoes. They will fly 15 miles.

Staining mosquitoes also enabled Mr. Clarke to assemble some astronomical figures on a peak hatching period. Thirty-one million mosquitoes were stained within a few days. The number was estimated by counting the larvae in one square foot and then figuring the acreage dusted. Among the 92,000 mosquitoes caught during the next 30 days there were 420 unstained mosquitoes for every stained one. Therefore, in a radius of 10 miles there were 420

(Continued to page 156)

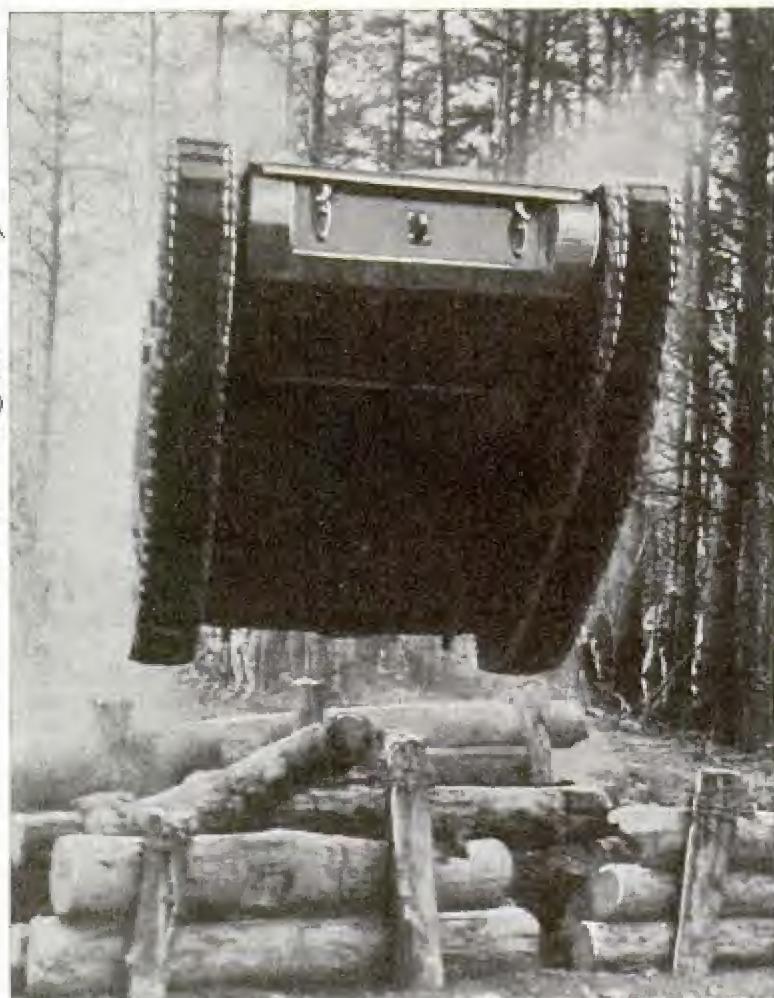


Photos courtesy Saturday Evening Post

Above, J. Lyell Clarke, noted mosquito abatement expert, catches insects on arm with test tube containing ether. Below, collecting the insects in a marsh



Timber Wall Sends Tank Flying In Obstacle Course Test



Timber barricade thrown up by army engineers hurls trapped tank in air

Logs piled up like jackstraws may splinter when a tank strikes them full tilt, but when the logs are part of a trap designed by the United States Army Engineers, the tank is stopped. In a test of the engineers' skill, a low barricade of timbers stretched across a trail and buttressed by other logs sunk into the ground not only halted the charging tank but threw it high into the air, during a demonstration at an eastern fort.

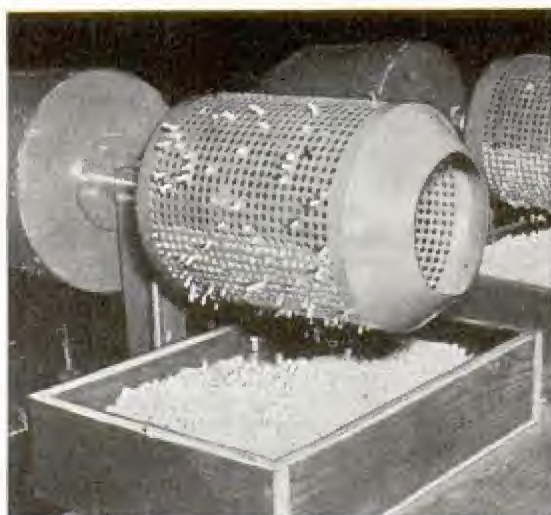
Honey Bee Is Vital War Worker In Three Different Fields

Beekeeping is an essential wartime industry, according to Dr. Leonard Clark of the biology department of Union College, because of the versatility of the bee and its products. Beeswax is used in polishing waxes for airplane wings, and as a pro-

5/11/10
tective coating and lubricant for shells and bullets, among other wartime uses. Bees also help out in the production of sweets; last year's honey production was estimated at from 150 to 200 million pounds. Perhaps the most important function of the honey bee is in pollination. Increases in yield of as much as 40 percent have been noted when a hive of bees was placed in each acre of apple orchards. Clover and other crops similarly benefitted.

'Lost' Rivets Sorted By Sifting Them Through Drum

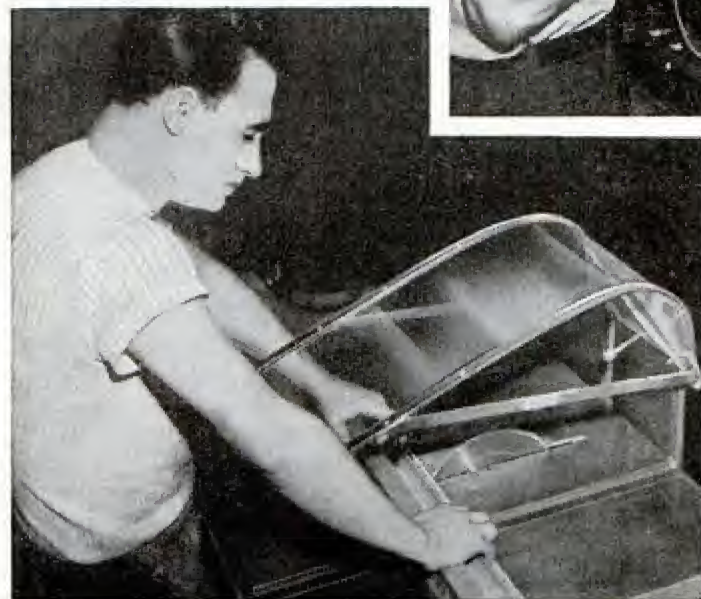
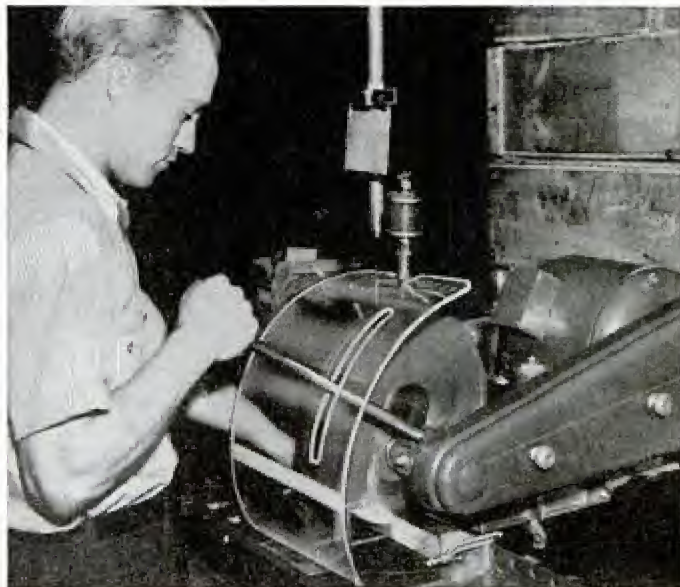
Aluminum rivets dropped by aircraft workers are reclaimed with a rivet sorting machine developed by the Fisher Body Division of General Motors. First, the "lost" rivets of assorted sizes are passed through a bank of revolving cylinders. Holes in the cylinders vary in size so the rivets are sorted according to thickness. A hopper carries them to a rotating disklike selector which sorts them according to head type, then separates them by length.



Revolving sievelike drums sorting reclaimed rivets by thickness; one machine sorts 200 pounds in a day

Shields of Clear Plastic Protect War Workers

Bushcraft Co., Wichita, Kansas



Self Aircraft 2049 Glenwood Buffalo N.Y.
Most industrial workers hate goggles, and that goes for aircraft workers, too. But the men and women who build planes did something about it. They figured the transparent plastic used in bombers to protect the crew and still provide visibility could do the same for them. Among the protective shields designed by workers is the one (above) over a soldering pot to prevent splattering of molten metal. Top right, plastic face shield catches flying tacks

Republic Aviation Corp. Detroit Mich.
Photos courtesy Rohm & Haas Co.
Above, splinters fly from the teeth of whirling saw but worker doesn't even blink for he is protected by a tough transparent shield. It was designed by engineers at Republic Aviation. Shields like this have reduced eye injuries in many plants

Left, another type of clear vision shield for saw. Many aircraft workmen, familiar with plastic material, make their own shields by heating plastic to about 300 degrees F. and then shaping it. The polishing and cleaning are done with bare hands

Padded Rest Supports Arm For Overhead Welding



Upright (arrow) is adjustable to suit welder's height

Attached to a swivel on a supporting belt, an arm rest for welders working on overhead jobs permits freedom of action while lessening fatigue. The padded rest caps an upright which is adjustable to the height of the wearer or the height of the job. The belt provides a means of carrying extra tools and rods.

Fishing Gear in Tackle Apron To Equip Navy's Life Rafts

Harrowing experiences of shipwrecked men and plane crews forced down at sea have convinced the Navy Department of the need to equip its ships and planes with complete fishing tackle gear, with which



"Living off the sea" is possible with tackle apron

shipwrecked or marooned men will be able to derive food in any waters of the globe. One kit, weighing three pounds, is to be installed on every oceangoing vessel, Navy or merchant marine, of over 3,000 tons, and will be placed in lifeboats and rafts. A smaller kit, weighing slightly over a pound, will be packed in airplane life rafts. The larger kit includes a 12-pocket apron into which are stowed dehydrated pork rind for bait, lines totaling 700 feet in length, an 8-inch harpoon head to be lashed to an oar for a spear or gaff, jigs and spare hooks of varying sizes, a knife, a collapsible net, a sharpening stone, and a pair of heavy work gloves. Included also is a complete angler's guide, printed on water-resistant Patapar. The smaller kit contains reduced amounts of similar equipment.

Rock Wool Insulation Anchored By Adjustable Gypsum Holder

Retaining holders made of gypsum are manufactured to hold rock wool insulation in place in such exposed areas as between



Slot in end of retainer fastens it in place over nail

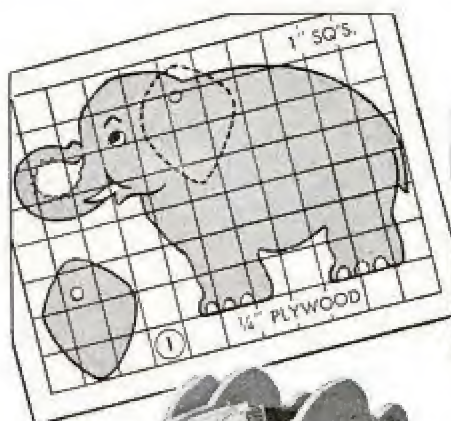
rafters, studs and joists. Fireproof and rotproof, the retainers are adjustable to any length between 16 and 24 inches, and are fastened by means of a slot that slips over a nail. They are said to increase the insulation's efficiency by preventing its slipping or falling out.

¶To learn where to buy commercial products described in these pages, see the index.



The CRAFTSMAN

Novel DESK SET

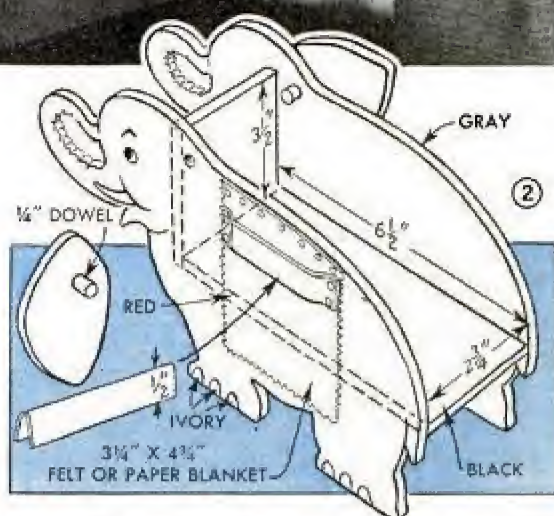


Easy for any small boy to make in the school shop or at home as a gift for dad on Father's Day

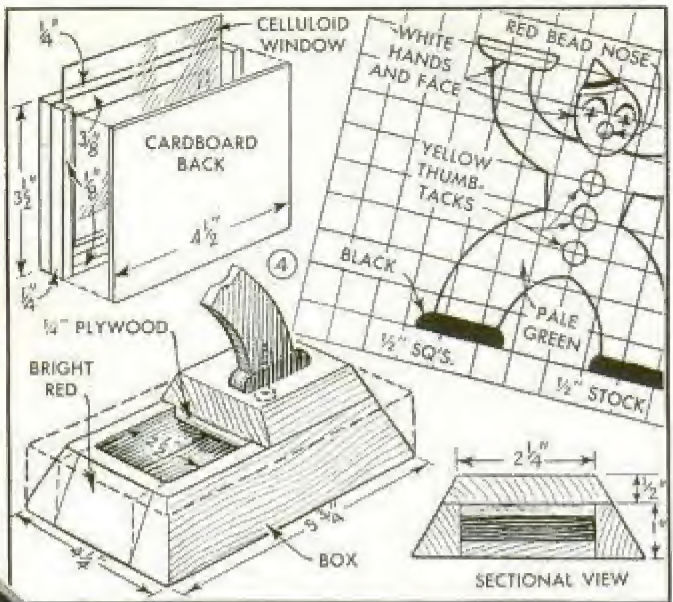
By Bess Livings Lee

DAD will appreciate this desk set all the more when he knows that you made it yourself. The team of elephants that form the sides of the letter holder curl their trunks to provide a place for pen and pencil and wear scratch pads on their backs for blankets, while the little clown perched atop a stamp box holds a calendar of the perpetual type in a wooden frame.

The elephant pattern given in Fig. 1 must be enlarged full size on 1-in. squares. This is quite easy to do by ruling on paper the same number of squares as are given in the pattern, then simply drawing in the outline to coincide with that shown in the corresponding square of the pattern. It's best to saw the two elephants at the same time so that both will be alike. To saw out the space inside his curled trunk, you'll



have to drill a small hole so you can insert the blade. Fig. 2 gives the size of the pieces to which the elephants are glued and nailed. The ears are sawed out separately and pivoted with short dowels. They should extend out from the body $\frac{1}{4}$ in. or so to provide space for a scratch pad on each side. A red blanket of imitation leath-



er, felt or stiff paper, having the edges pinked, is attached to each elephant with a row of brass escutcheon nails across the top, after which 1-in. strips of matching material are folded lengthwise and nailed at each end as shown to take the cardboard backs of the scratch pads.

The stamp box, Fig. 3, which forms a base for the calendar, is built up of 1-in. stock in the manner shown in Fig. 4, the $\frac{1}{4}$ -in. bottom being set in last. Note that a separate piece of $\frac{1}{4}$ -in. wood is nailed to the underside of the lid to keep it in place.

Beveling is done with the lid in place, clamping both parts in a vise and sawing off first the ends and then planing the sides to correspond. The clown pattern is enlarged in the same way as was done before, except on $\frac{1}{2}$ -in. squares, and is cut from $\frac{1}{2}$ -in. pine. A small wooden bead forms his nose and a row of colored thumbtacks simulate buttons on his suit. A small screw into each foot fastens him to the box lid. The calendar frame is sawed out in one piece and has strips glued to the side and bottom edges to which cardboard is glued to form a pocket for the calendar cards. Suitable cards can be purchased at most stationery stores. The frame is attached to the clown's hands with glue and brads.

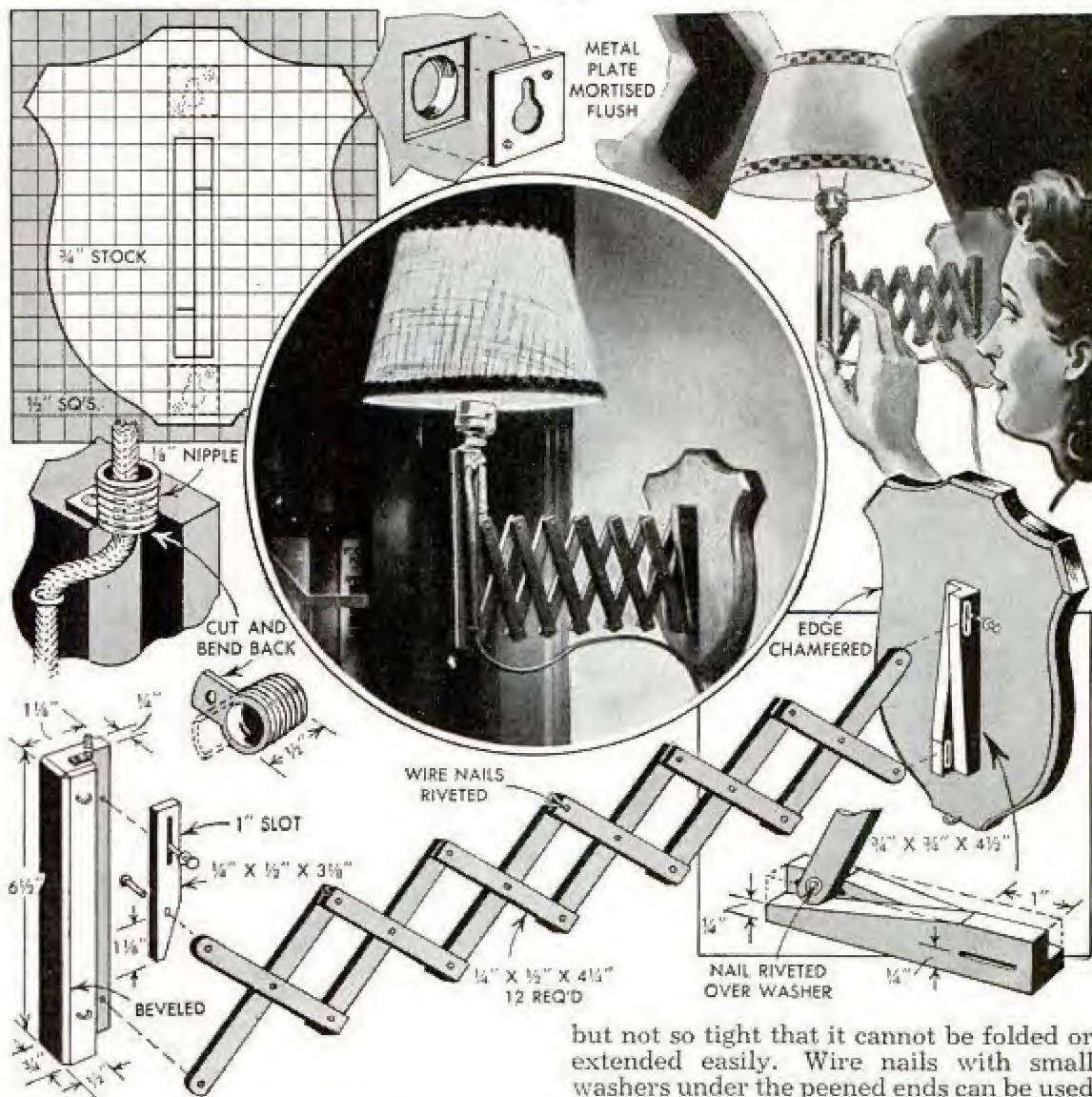
Magazine Rack Provides Surface for Writing When Seated



Doubling as a desk that can be supported on your lap while sitting in a chair, this magazine rack permits you to lean back and relax while you write. Although almost any similar kind of rack will serve, the one shown was designed especially for the purpose. It has one vertical and one slanted side, and the bottom projects beyond the lower edge of the slanted side, forming a convenient ledge to hold pen and pencil. When the rack is on your lap, there is no projecting edge to cause discomfort. Light plywood or hard-pressed board is used for the sides and partition, but the ends should be $\frac{3}{8}$ or $\frac{1}{2}$ -in. solid stock.

Excessive use of upholstered furniture often makes a room seem "stuffy," but this can be relieved by use of occasional pieces of wood furniture such as a delicate mahogany end table or side chair.

Lazy-Tong Pin-Up Lamp Extends Over Chair



Hung at any desired place in a room, this pin-up lamp folds to within 5½ in. of the wall when not in use, and extends to 16 in. for reading, playing cards, etc. Made of walnut or other suitable hardwood, the lamp consists of a lazy tong, one end of which is hinged to a shieldlike wall bracket, and the other end to a post that carries the socket and bulb. To attach the socket to the post, a short ⅛-in. pipe nipple is used, a portion of one end being cut away after which the resulting tab is bent up at right angles and screwed to the top of the post as indicated. The socket is screwed to the other end of the nipple. The lamp is hung on two screws, driven into the wall so that their heads project to fit keyhole slots in a metal plate which is set flush in the back of the lamp bracket. In making the lazy tong, rivet the joints fairly snug

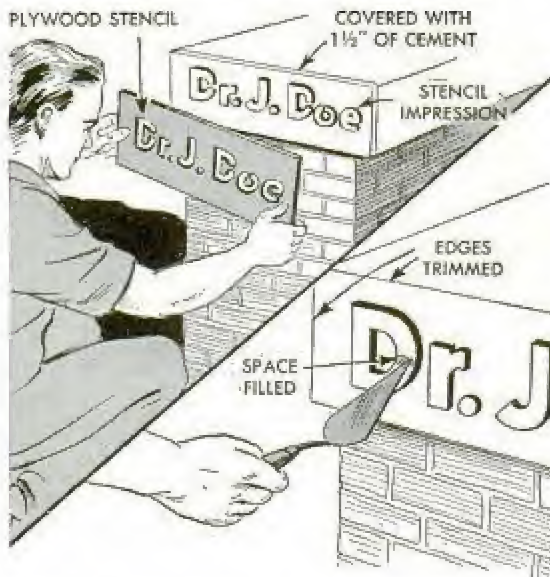
but not so tight that it cannot be folded or extended easily. Wire nails with small washers under the peened ends can be used for rivets.

—William E. Gass, Jr., Paterson, N. J.

Cork and Pin Hold Small Tidbits In Canary Cage

Difficulty of feeding small pieces of apple or other tidbits to a canary may be overcome if the food is impaled on a pin which is pushed into a cork that fits snugly between the wires of the bird's cage. If the food is somewhat soft, it may be necessary to use a pin having a large head so the bird in picking at the food does not pull it off.

Raised Letters in Stone Imitated With Stencil and Cement



Lettering that closely resembles that cut in relief in stone can be made by anyone. First, cut a stencil in metal of the desired lettering. Then coat the surface to be lettered with thick portland cement and fine sand, making the coating as thick as possible. Now, while the cement is still soft, press the stencil into it. Do this very carefully so that the cement pushes through the openings in the stencil. When the latter is removed, fill the spaces left in the lettering by the connecting pieces of the stencil. If the letters are a little ragged at the edges, smooth them with a trowel.

Cloth Belt Turned Easily

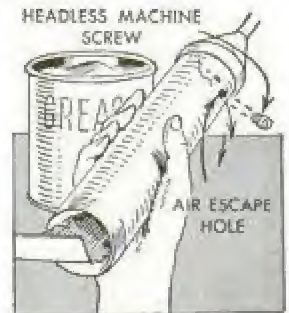
When making a cloth belt for a garment, place a length of tape inside before sewing the belt together, stitching one end of the tape to the end of the belt as you close the latter. Then, to turn the belt right side out, just pull on the free end of the tape and



slide the cloth back over it and the job is done. Clip off the tape close to the seam and keep it for the next belt that you make.

Small Hole in Grease Gun Barrel Prevents Trapped Air

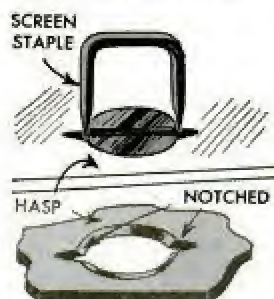
The annoyance of having air trapped in a grease gun can be avoided by drilling and tapping a small hole in the barrel of the gun near the lower end. Put a screw in the hole to plug it while the gun is in use. When filling it, remove the screw so air can escape as grease is pushed in.



Magnet in Crankcase Drain Plug Collects Metal Particles

To avoid the circulation of metal particles in the oiling system of an old-model car or motorcycle, it is a good idea to fix rigidly in the drain plug of the crankcase sump a suitable piece of magnetic steel. When doing this, be sure that it does not stick too far inside the crankcase.

Hasp Screws "Locked" in Place By Using Screen Staples

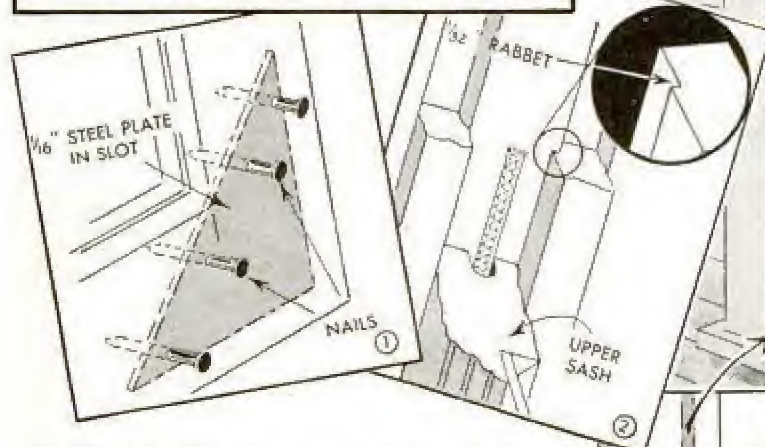


Many door hasps that are fitted with padlock loops have exposed screw heads, which can be unscrewed and the hasp removed, making the lock ineffective. One way to prevent this is to file V-

notches in opposite sides of the screw holes in the hasp. Then when the screws are driven in place the slots in their heads are turned to register with the notches, after which screen staples are driven into the wood through the openings filed in the hasp as shown. Once the staples are driven home it is impossible to turn out the screw.

☐ Sash pulls always should be provided on the lower sash of a window for raising it, because if it is lifted by the top rail, the joint between the rail and stiles may be broken, especially if the sash sticks.

Attention to WINDOWS

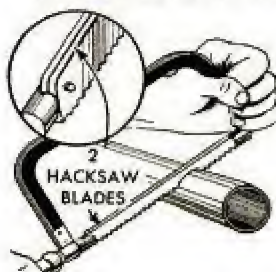


ALTHOUGH often neglected, windows need attention just as frequently as the rest of your home if they are to last and keep out rain and cold air. If a sash frame has rotted at the lower corner so that the tenon is weakened or has broken, it can be repaired as indicated in Fig. 1. To do this, remove the sash and make a diagonal saw cut as deeply as possible at the corner. Then draw the parts together tightly with clamps and insert a triangular piece of sheet metal in the saw cut and nail it in place, cutting the projecting ends off flush with the wood. Fig. 2 shows how to repair a loose, rattling sash. Remove the two outer stop strips and replace them with new ones, making them about $\frac{1}{2}$ in. wider than the originals. Rabbet one face of each strip so that it will fit the groove in the window frame. Then place the strips with the offset face next to the sash frame and drive them in place. Another way of tightening loose sash and also of weatherstripping them is to cement narrow strips of thin felt to their sides where they contact the stop strips. Put the felt on the inner sides of the sash where it is less likely to get wet. Still another method is to use a few thumb-tacks instead of felt. This latter method prevents rattling, but does not seal the windows against drafts. Moisture collecting in the corners formed where the inner and outer window-stop strips meet the sill often is a cause of rotting at these points. The damage can be avoided by cutting a short bevel across the inside corner of each strip as shown in Fig. 3, so that water can drain away quickly. If you have noticed cold air coming in around the check rail of an old window, this can be prevented by cutting a groove about $\frac{3}{8}$ in. deep in the



rail of the upper sash and inserting a strip of felt in the groove, as in Fig. 4. The felt should project about $\frac{1}{8}$ in. from the groove. When the window is closed and locked, the felt strip will prevent any leakage of air or rattling at this point. A combination of the felt strip just mentioned and those described in Fig. 2 will make any window virtually airtight, but still allow it to be opened and closed without difficulty.

Thin Tubing and Metal Cut Easily With Double-Bladed Hacksaw



When a hacksaw is used to cut thin tubing or metal, the teeth often are broken from the blade because of the thin material. To avoid this, use two blades in the saw frame. This gives the effect of both strengthening the cutting blade and staggering the teeth, thereby providing a finer cutting edge.

—Joseph Keenan, Fort McIntosh, Tex.

Solving HOME

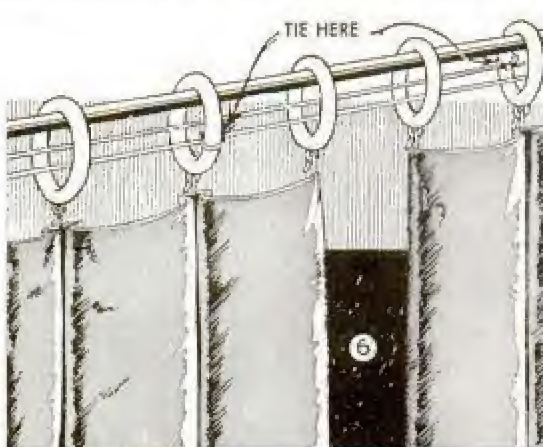


RUBBER BAND

1—If you live in a house or apartment where the bathroom does not include a small clothes-drying rack, a heavy rubber band or cord stretched between two hooks provides an excellent place to hang silk stockings and other light garments



3—Instead of cutting a lemon for only a few drops of juice, just pierce it with a fork and squeeze out the desired amount. 5—Knitting needles are carried safely in this holder which consists of two corks fastened near the ends of a small dowel



TIE HERE

6

2—Tiny shreds from a hard bar of laundry soap are produced quickly by scraping the bar across three bottle caps screwed to the washboard. 4—Before slipping clean curtains onto flat metal rods, one housewife forces a table knife into the rod to prevent tearing the hems



TABLE KNIFE

BOTTLE CAPS

BRAD

KNITTING NEEDLES

DOWEL

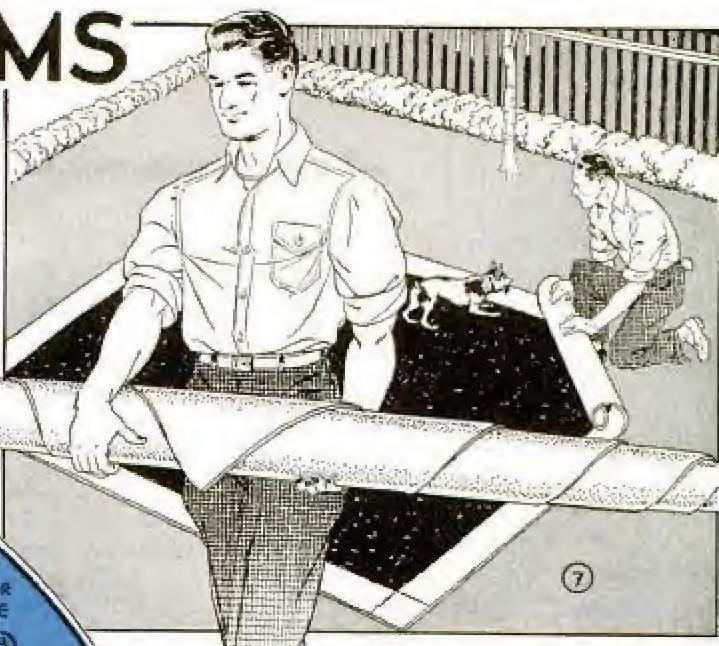
CORK

6—Where a pair of draw curtains are operated with a cord arrangement of the type shown, the usual trouble of closing them tightly can be overcome by simply tying the cord to the second ring on each curtain instead of the first one. This permits material between the rings at the center to form folds and hang close together when the curtains are drawn

PROBLEMS

8—A handy razor-blade holder is improvised quickly from a small hinge, two stove bolts being used to lock the blade in place. Of course, this requires a hinge with holes matching the blade openings.

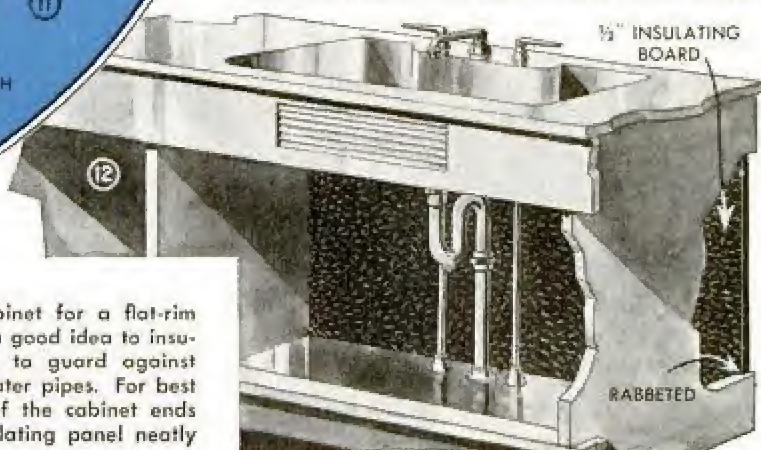
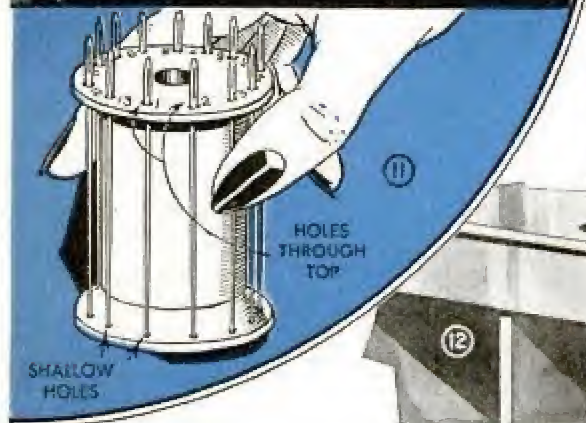
9—As fresh laundry soap contains considerable moisture, unwrap it and let it "age" a few weeks before using so that it will last longer



7—Next time you clean house, try rolling the large rugs diagonally before picking them up. In this way, they can be carried without buckling or "breaking" as most of the weight is in the center which makes the ends lighter and easier to support

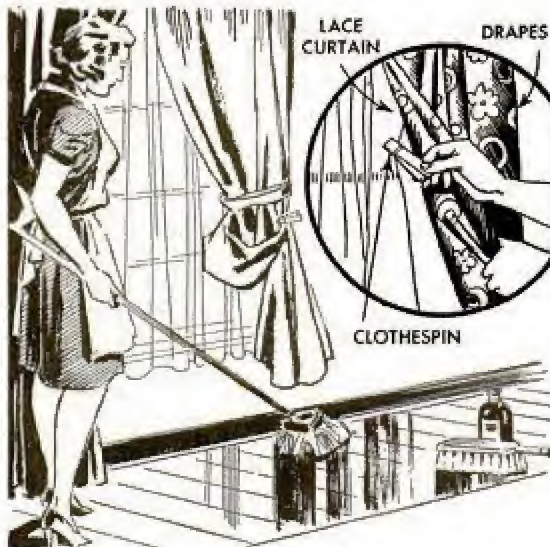


10—When pressing heavy seams, ridges can be avoided by sliding strips of paper under the loose ends before spreading a dampened cloth over the area. 11—Improvised from an empty thread spool, this handy holder for needles keeps them in order



12—In building a permanent cabinet for a flat-rim sink against an outside wall, it's a good idea to insulate the compartment as shown to guard against undue cooling and freezing of water pipes. For best results, rabbet the back edges of the cabinet ends and top so they will fit the insulating panel neatly

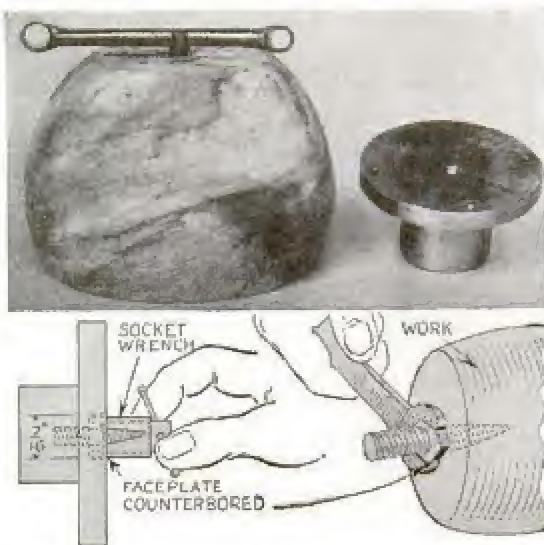
Clothespin Holds Up Draperies While Cleaning Floor



You can avoid soiling the lower ends of drapes on a mop if you use a spring-type clothespin to hold them up when cleaning the floors. The pins may be painted to harmonize or contrast with the color scheme of the room. Snapped to the edge of the curtain behind the drape when not in use, the pins are always at hand when needed.

Improved Faceplate for Lathe

When the work is removed from a wood-turning faceplate of the type that has a screw center threaded into it as shown, the center nearly always stays in the work. This makes it necessary either to take hold of the base of the center with a pair of pliers to turn it out of the work, which ruins the machine threads, or to cut away enough of the work with a chisel to get a wrench



on the hexagon-shaped shoulder of the center. This trouble can be avoided by turning a hole in the center of the faceplate large enough to permit a socket wrench to slip over the shoulder. The hole should be deep enough to bring the shoulder just slightly below the surface of the plate, allowing only the screw portion of the center to project. In this way, the shoulder will project above the work, when the latter is removed, so that the center can be turned out of the work with a wrench.—J. O. Cavanaugh, Portland, Ore.

Make Your Own Masking Tape

If you need masking tape to cover portions of some work while painting it, you can make the tape inexpensively by using heavy manilla paper coated on one side with an adhesive consisting of cabinet maker's glue, 1 oz., dissolved in hot water,



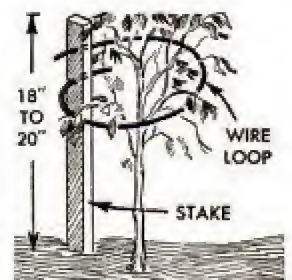
1 pt., to which is then added yellow laundry soap, $\frac{1}{8}$ cake. When cool, this mixture provides an adhesive that will stick tightly to the work, yet permit the paper to be pulled off easily

when desired. After the paper has been removed, the adhesive sticking to the work can be washed off with clear cold water.

Good Stake to Support Plants

Tall-growing plants, such as tomatoes, dahlias, giant zinnias, and others need to be supported by staking before they reach ultimate growth.

One simple way of doing this is by means of a wooden stake, which is driven into the ground near the plant, and a loop of heavy wire passed around the plant 18 or 20 in. above the ground,



the free ends of the wire being forced through small holes drilled near the top of the stake. If possible, the stake should be driven at the time the plants are set out in the garden to avoid damage to the roots.

¶Sewed on the inside of a trouser cuff flush with the edge of the cloth, a small strip of leather or chamois skin will prevent fraying.

This Wheeled Shopping Basket Has Many Uses



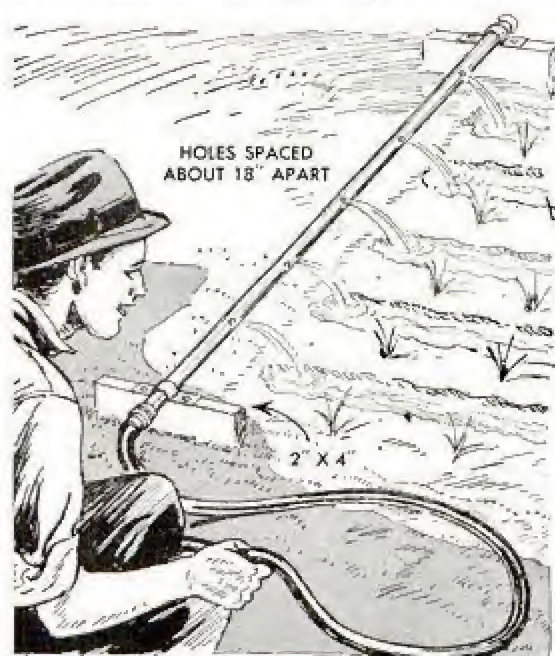
Women members of your family will find many uses for this simple, inexpensive cart. It is ideal for hauling groceries from the store, for carrying wet clothes from the laundry to the drying line, and it can even be pressed into service as a portable refuse container. If two or three baskets are kept on hand, they can be interchanged, thus making cleaning unnecessary for different uses. To make the cart all you need is a pair of small wheels and axle, and a fruit or vegetable basket like the one shown. On the cart shown above, the chassis from a small tricycle was used and a handle from a discarded lawn rake, shortened to suit, was attached by bolting it to the tricycle chassis. A hand grip on the end of the handle was made from a piece of flat iron. Two coats of paint give the cart a neat appearance.

—Robert J. R. Rockwood, Pasadena, Calif.

Simple Irrigating System to Keep Your Garden Growing

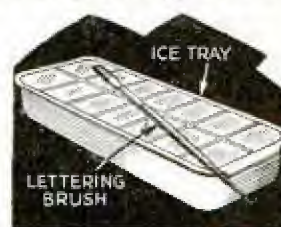
By using this simple irrigating system to water your garden you not only save time, but you also save water, as there is less loss from evaporation when you irrigate than there is when you sprinkle with a

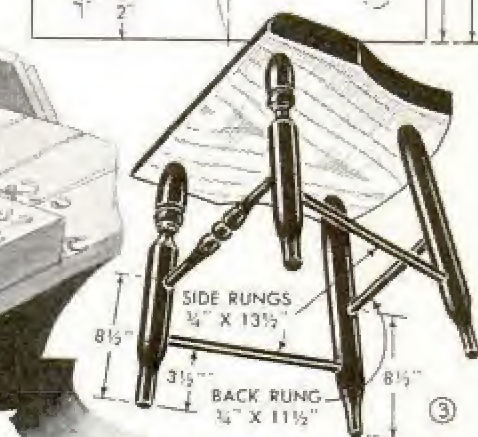
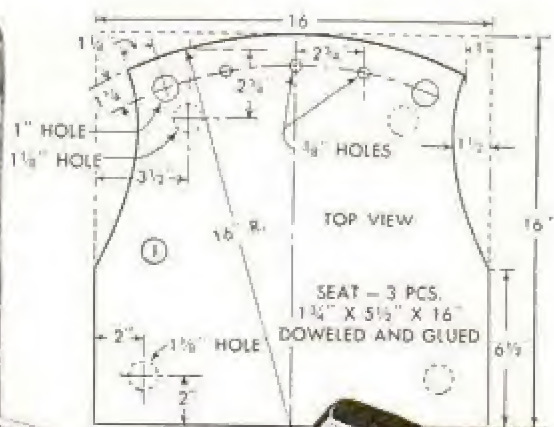
hose. Sprinkling, of course, requires your constant attention, which is not necessary when you irrigate. To install the system, all you need is a suitable length of $\frac{3}{4}$ -in. pipe, which is capped at one end and provided with a fitting at the other to take a garden hose. Wood blocks support the pipe, which has $\frac{1}{8}$ -in. holes drilled in one side to direct the water into trenches between the rows. After irrigating, fill the trenches immediately with soil to keep the sun from drying out the wet ground.



Freezing Restores Lettering Brush

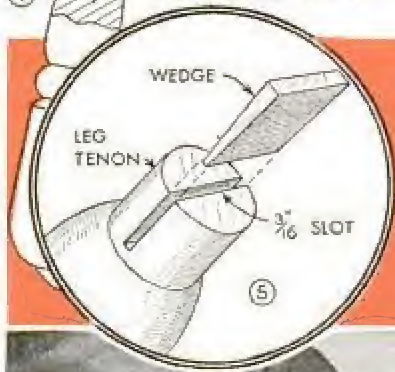
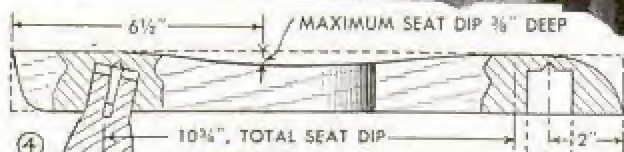
Chisel-pointed lettering brushes that have been neglected or abused until the bristles refuse to respond to ordinary treatment for restoration often may be reshaped by dipping them in water, shaping them and then freezing them in the ice-cube compartment of your refrigerator. The brushes should be allowed to remain frozen a day or two.





PIONEER

Copy of a rugged chair fashioned by pioneers of the Ohio valley in 1827, and still in daily use. Simple design makes it easy to duplicate



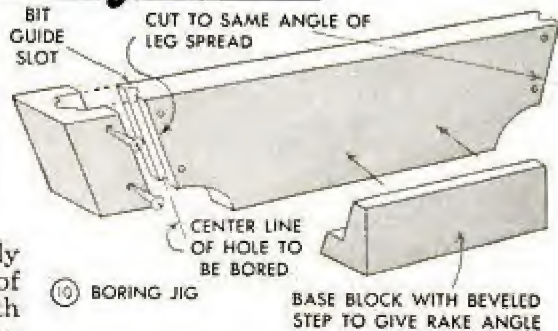


CHAIR *lasts a lifetime*

By Alexander Maxwell

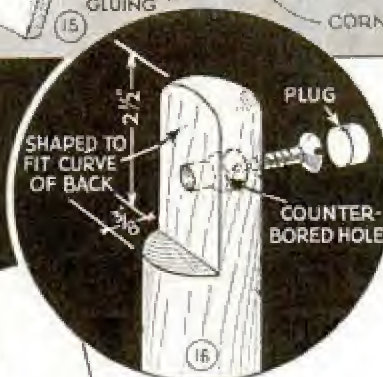
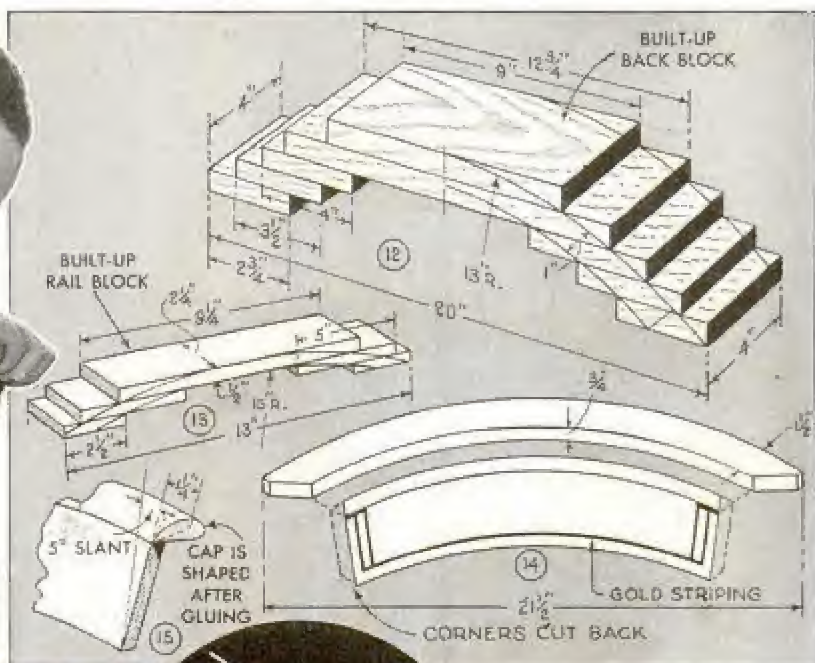
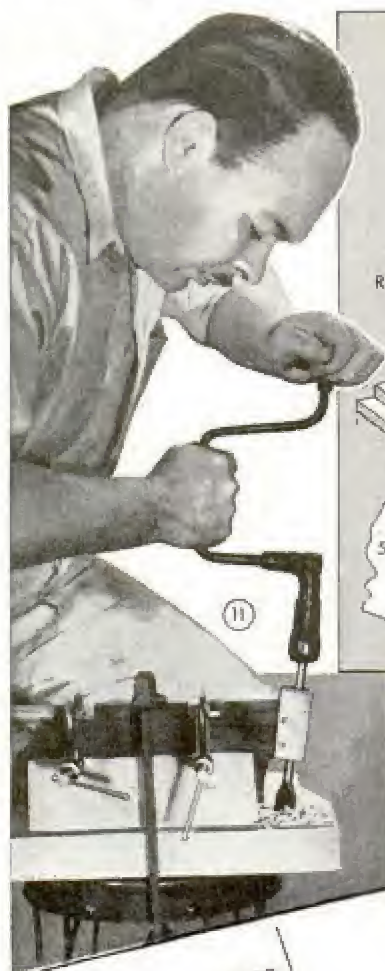
REPRESENTING the design of no one cabinet maker but rather the incorporated designs of many, the quaint chair shown in Fig. 8 is typical of those fashioned and used by the settlers of the Ohio Valley. Like most early pieces of furniture, the plain ruggedness of this chair makes it easy to reproduce with few tools. And, if care is used in fitting the parts together, it will last a lifetime.

Maple, birch and mahogany are the best woods to use. Start by making the seat first. For this you will have to glue and dowel together edgewise three pieces of 1¾-in. stock to build up the 16-in. width required. Place the pieces so that the grain of each runs in the same direction and use a waterproof resin-type glue to assure strong joints. Fig. 1 shows the plan of the seat. You will find it easier to carve the dip in the seat before bandsawing as the contour of the dip is drawn on the straight edge of the work. Using a chisel, block plane, spoke shave and a scraper blade, the seat is worked down to the guide lines as shown in Fig. 2, after which the front and back edges are rounded according to Fig. 4 and then the seat is given a good



sanding. Referring back to Fig. 1, you now lay out the position of the holes for the legs. Boring these to provide the right spread to the legs is simplified by using a jig like the one detailed in Fig. 10. Each end of it is cut and grooved at an angle of 98 degrees, which represents the sideward spread or slant of the legs. See Fig. 17.

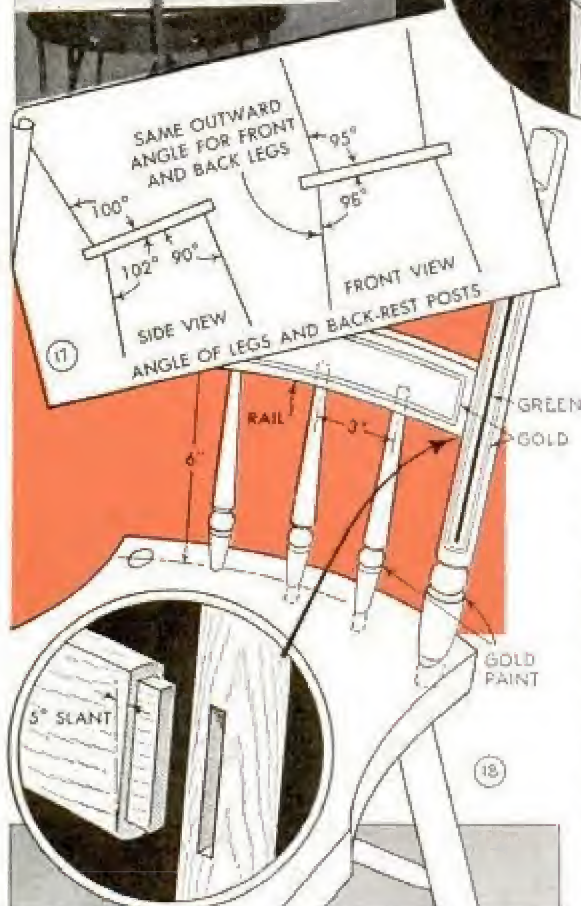
In use, the bit is held in line with the slanting end by a grooved block which fits around the bit shank and over the end of the jig as shown. This block will do for both ends of the jig. To give the bit the correct backward rake for boring the holes for the back legs, a base block is required having a rabbet cut in it at a 102-degree angle. This block is placed under the jig to which it is clamped with C-clamps and, in turn, the two parts are clamped to the



seat across its width as shown in Fig. 11. As the front legs slant only sideward, the use of the base block under the jig is not necessary in boring the front holes. The leg holes, being $1\frac{1}{8}$ in. in diameter, require the use of an expansive bit, although if one is

not at hand the holes can be bored with a 1-in. bit and the leg tenons turned accordingly. Watch to see that the spur of the bit does not pierce the top surface of the seat.

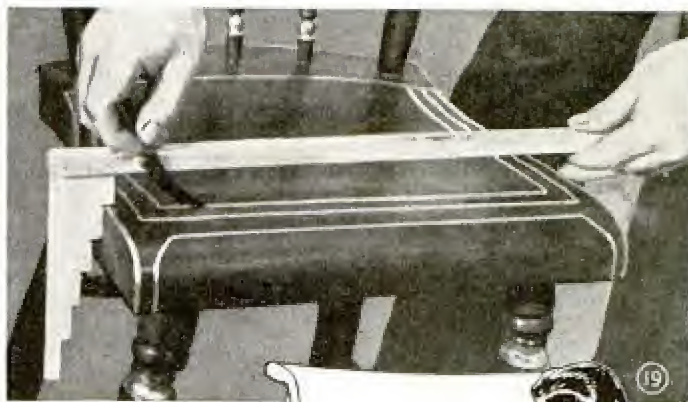
Now you are ready to turn the legs and the other parts needed to complete the chair. Fig. 7 gives their size. Duplicate beading on the legs and posts should be matched as nearly as possible, using calipers as shown in Fig. 6 to transfer the contour of one to the other. After you have the legs turned, their tenons are slotted as shown in Fig. 5 to take short wedges, which should be slightly wider than the slot to spread the latter when forced into the seat. In driving the legs in place as in Fig. 9, follow these progressive steps: First, bore the two front legs to take the front rung, referring to Fig. 3 for the exact location. Glue the rung in the holes and drive the legs as a unit into the seat. When dry, bore the front legs for the side rungs. These are at right angles to the legs and run parallel to the seat. Next, glue the back rung to the back legs, then the side rungs to the front legs. Finally, drive the back legs into the seat, springing in the glue-coated ten-



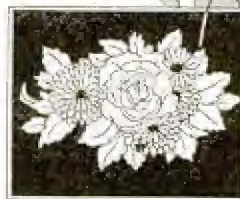
ons of the side rungs as you go. You probably will have to trim a little off one of the legs to make the chair stand level, as it is almost impossible to drive each leg in the same distance.

To bore the holes in the top of the seat for the back posts, the slanting ends of the jig will have to be recut to an angle of 95 degrees, and another base block having a 100-degree rabbet will be needed to give the desired rake to the chair back. The curved back and rail can be cut economically from blocks of $\frac{3}{4}$ and $\frac{1}{2}$ -in. stock respectively, built up in the manner shown in Figs. 12 and 13, although if you are able to get stock of the right thickness, they can be made in one piece. Glue one lift at a time, clamp and let dry before adding the next one. The radius is then drawn on the edge as shown and the work is bandsawed, scraped and sanded smooth. The front edge of the curved cap fits flush with the inside face of the back and is shaped as shown in Figs. 14 and 15 after being glued. The chair back is assembled by first driving the three spindles into the seat and then gluing the rail to the upper ends. After this, the post tenons are fitted with wedges as used in the legs and the left-hand post is driven in place, the rail tenon being sprung at the same time into the mortise provided for it. Do the same for the right-hand post and place a bar clamp across both. Fig. 16 shows how the upper ends of the post are notched for the curved back piece, the screws being concealed with wood plugs.

Much of the Ohio Valley furniture was stained a dark red to look like African mahogany and ornamented with fine gold and green hair stripes before being varnished. A stepped maul stick like the one shown in Fig. 19 will help guide the brush in striping the chair. A coach striper's dagger brush is preferred, although a fine water-



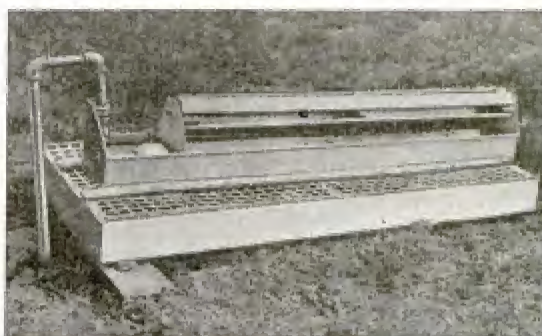
(20)
FLOWER DESIGN
ON CENTER RAIL
CAN BE A TRANSFER
OR HAND PAINTED



color brush will do. Practice on scrap work first, and see that the gilt is thin enough to flow freely. Try to complete the stripe in one long even stroke, guiding your fingers from the elbow. There is one green stripe on each front leg and on each post, also a band of green encircling the seat. The rest of the striping is done in gold. Of course, if you prefer, you can leave the striping off entirely and apply just a floral design to the center of the back rail for a touch of decoration as shown in Fig. 20. If a varnish finish is applied, rub down each coat with extra-fine steel wool and finish the last one with rottenstone and oil, after which apply wax and polish to a high luster.

Screened Base Keeps Automatic Chicken Waterer Clean

To avoid the unsanitary conditions caused by poultry splashing water from their automatic drinking fountain, one farmer uses the base shown in the photo. It consists of a framework of 1 by 4-in. stock covered with heavy wire mesh. When the fountain is placed on the base, poultry must stand on it to reach the fountain and any water splashed out runs down through the wire where it quickly soaks into the ground and cannot be trampled into mud by the chickens. This keeps a sanitary condition around the fountain.



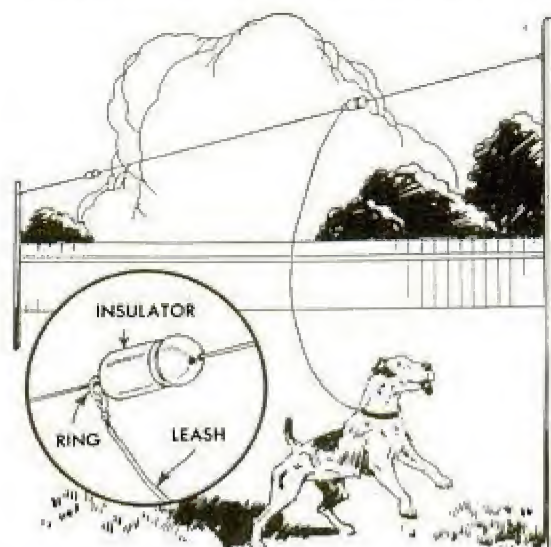
Billfold Is Worn Inside Trousers To Guard Against Theft



When working late at night, one collector guards against the possibility of having his zipper-type billfold stolen by wearing it inside his trousers as shown. This is done by fastening it to a strong cord fitted with watch-chain snaps, an eyelet in each end of the billfold providing a solid place in which to hook the snaps.

Stops on Dog's Run Wire Prevent Leash Wrapping Around Posts

If you have a run wire stretched between two posts so that your dog can get exercise and yet be tethered, the dog can be prevented from wrapping its leash around the posts as shown. Two insulators tied into the wire stop the leash and prevent the dog from reaching the posts.



Jointed Pony Serves as Model To Draw Lifelike Silhouettes

Besides being just a toy, this jointed pony and cowboy will be helpful in drawing horse silhouettes in lively, lifelike poses. The jointed parts are made to work snugly so that the pony will hold his pose when laid on paper and traced. The resulting outline, although somewhat rough, will give the approximate shape, making it simply a matter of blackening in the figure to make it a silhouette. Working from patterns enlarged full size from the squared profiles given at the bottom of the opposite page, you first cut out the central section or core of the body, including the neck, head and tail. The body is built up by gluing $\frac{3}{8}$ -in. pieces to each side of the $\frac{1}{2}$ -in. core, applying glue to just the surfaces of the core that are fixed and seeing that the glue does not work into the joints. The $\frac{1}{8}$ -in. pieces covering the outside of the body are cut to exactly the same shape as the $\frac{3}{8}$ -in. pieces, except that no cutouts are made for the legs. All five sections comprising the assembly are pivoted at the center hole. The ears are a separate unit so that they can be moved. The saddle is carved as detailed, although if the pony is to be used mostly for drawing, the saddle can be omitted. When attached at the angle shown, the cowboy's legs will clamp him on the pony.

Keep Paper Away From Funnel When Filtering Solutions

The next time you use filter paper in a funnel to clean solutions and they seem to pass through the paper too slowly, push three stirring rods between the sides of the funnel and the paper. This will keep the paper from touching the sides so that the liquids will pass through it more quickly.



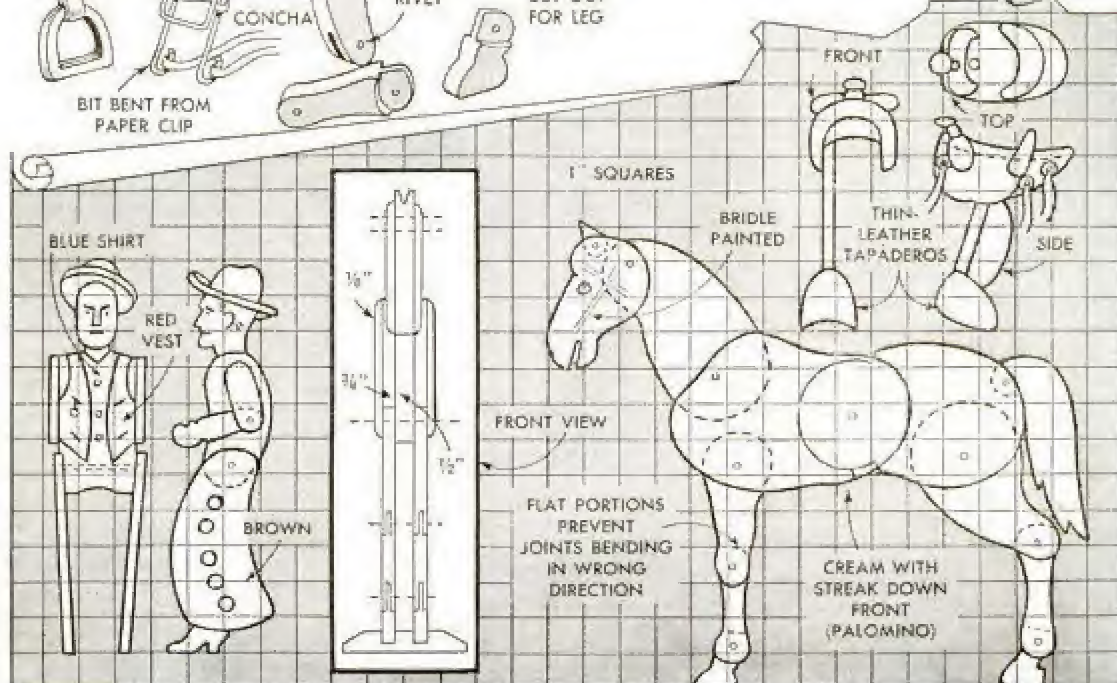
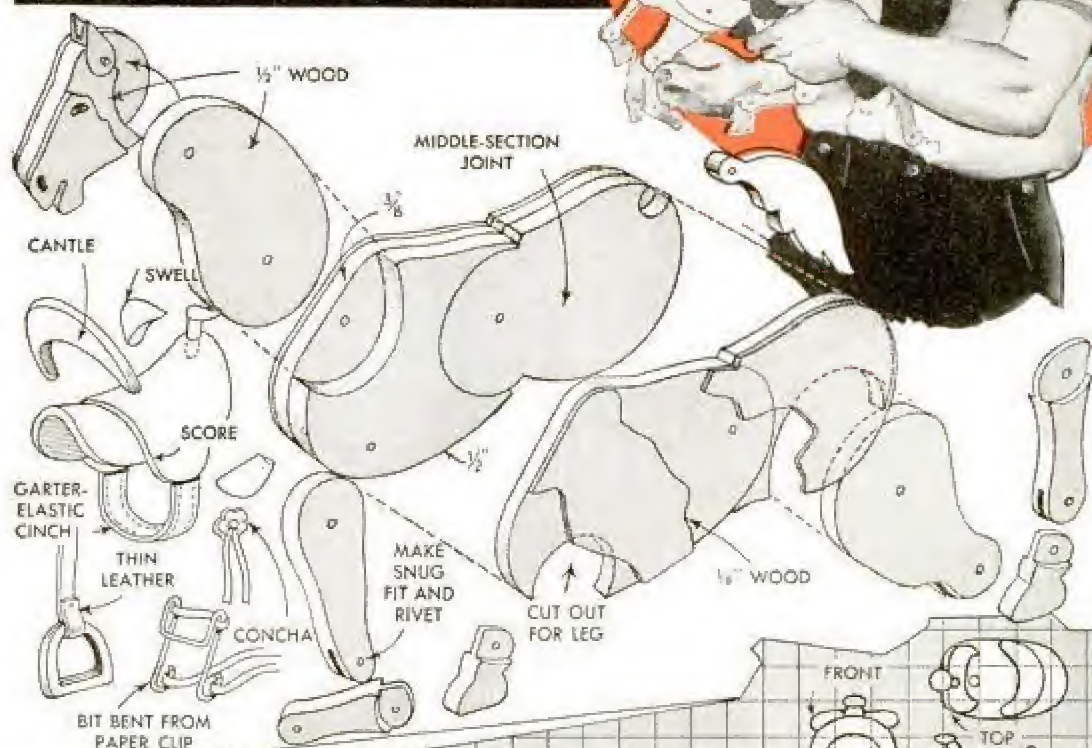
WRITE FOR POPULAR MECHANICS!

Readers are paid cash for ideas printed on these pages. You too may know of a simpler, faster or better way to do some daily chore about the home, farm, office, shop or garage; an aid to amateur photographers, model makers, workshop fans, car owners, hobbyists, etc. Just send a short but complete description plus a sketch or photo to the Homecraft Editor of Popular Mechanics. Checks sent promptly for accepted ideas.



JOINTED PONY

has many poses



Small CABINET-TABLE

NOTE: THREE DRAWERS OPEN FROM EACH END OF THE TABLE. THE THREE SIZES OF DRAWERS ARE IDENTICAL PAIRS

TABLE OVERALL DIMENSIONS
HEIGHT-30"
WIDTH-38"
LENGTH-50"

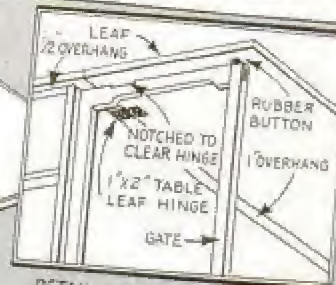
EDGES FACED

SET HINGES FOR LEAVES 4" FROM EACH END

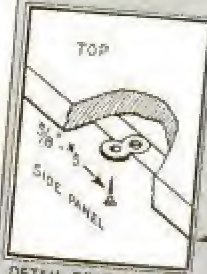
LEAF PLYWOOD

TOP PLYWOOD

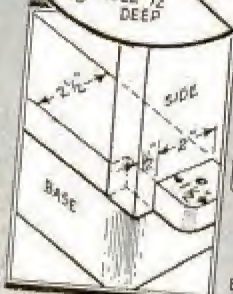
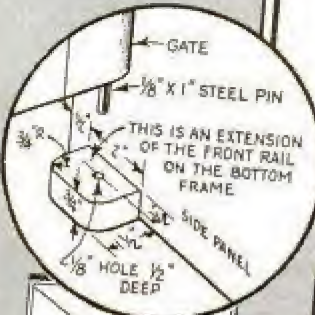
LEAF PLYWOOD



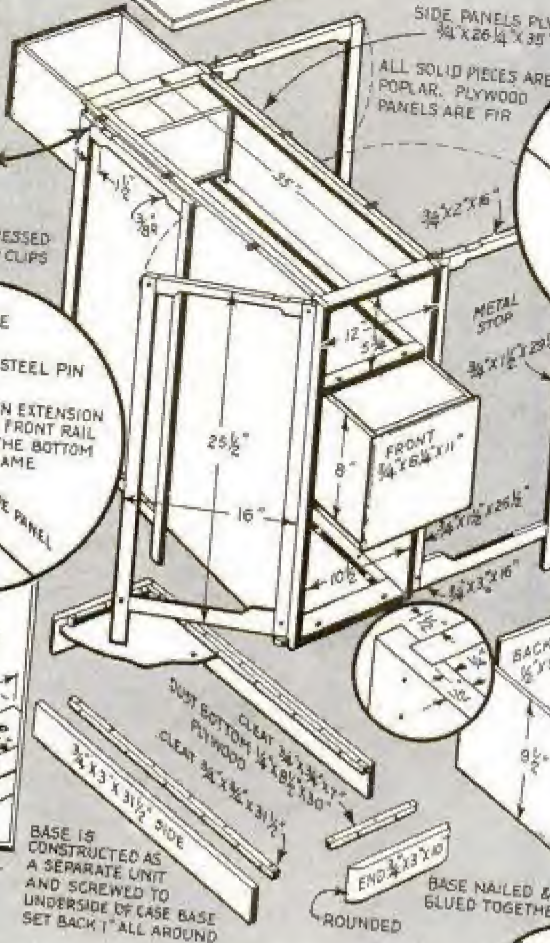
DETAIL OF UNDERSIDE OF LEAF



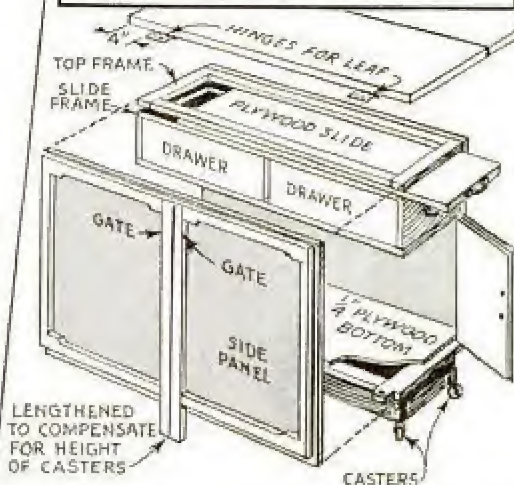
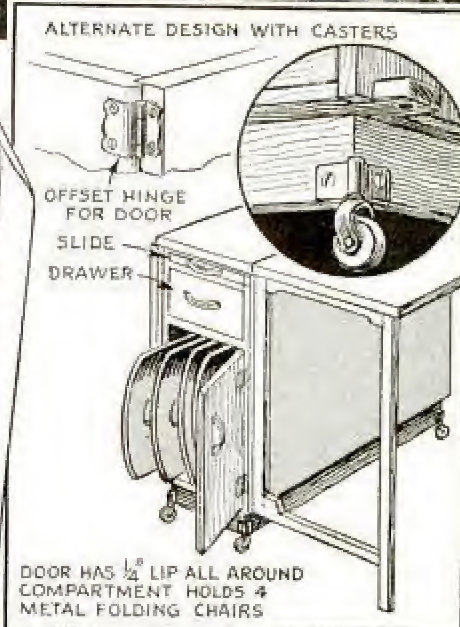
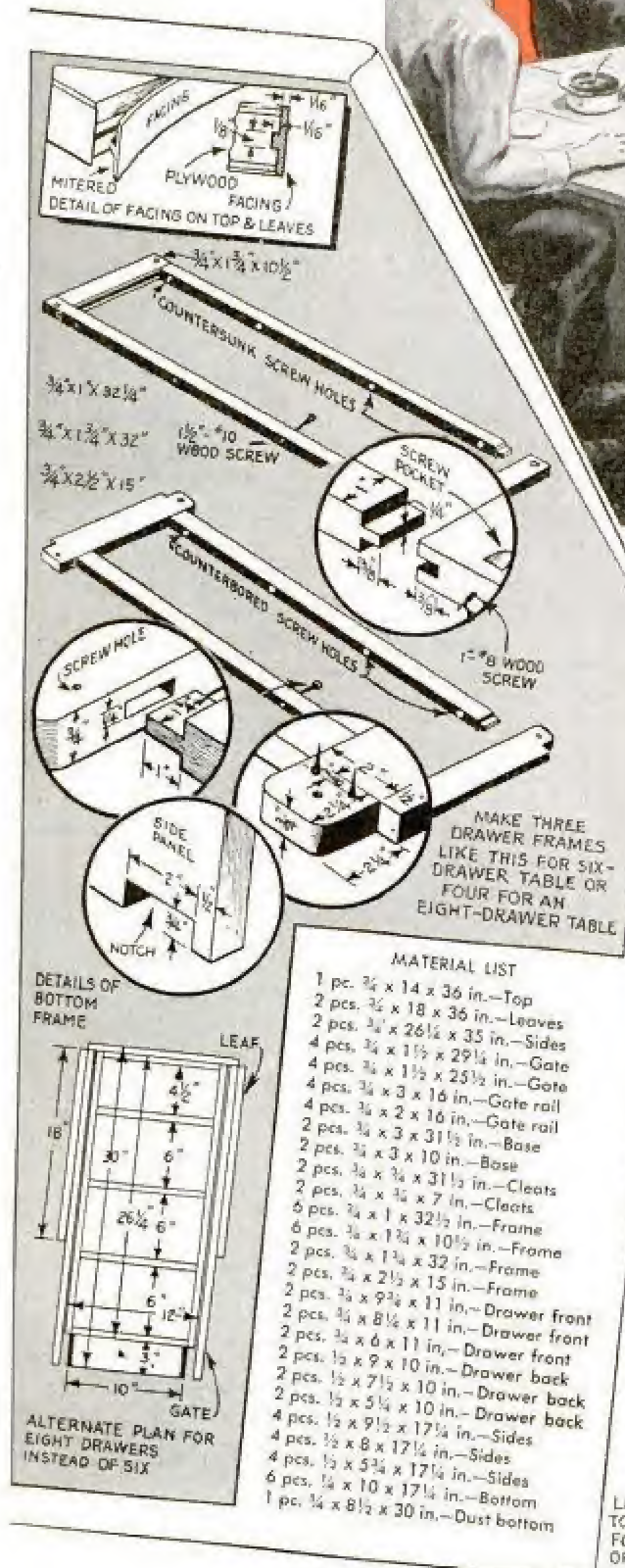
DETAIL OF TOP CLIP
TOP RAIL OF GATE IS RECESSED SLIGHTLY TO CLEAR TOP CLIPS



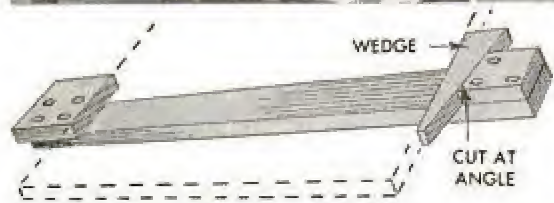
GATE SUPPORT DETAIL



Just the thing where living quarters are compact, this space-saving dinette table has a built-in chest of drawers, accessible from either end, in which linens and tableware can be kept handy. Folded, it forms a slender cabinet that can be set out of the way. When open, you have a full-size table accommodating six persons. By providing a cupboard under the drawers, a storage space can be had which will accommodate four folding card-table chairs. Construction is not difficult, and where plywood is not available, glued-up panels of solid stock can be substituted

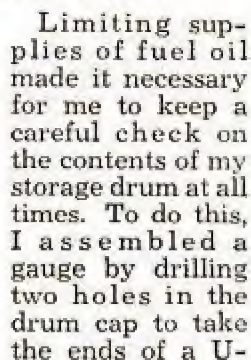


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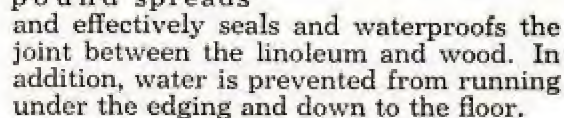
Stopping Water-Pump Squeak

Simple Gauge for Fuel-Oil Drum Indicates Present Supply

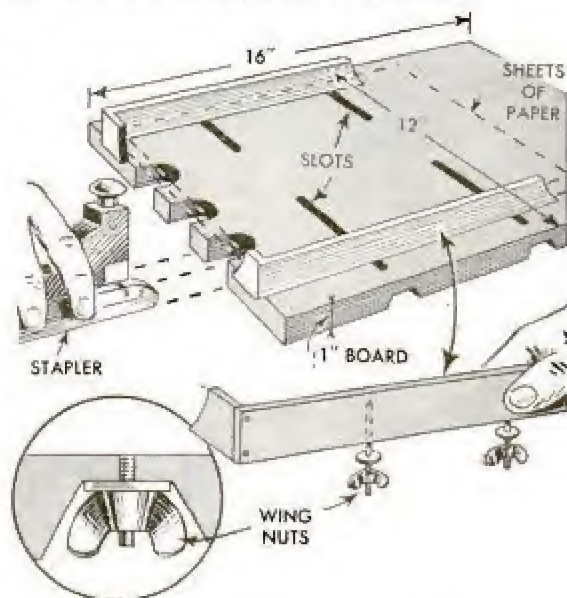


—G. E. Hendrickson, Argyle, Wis.

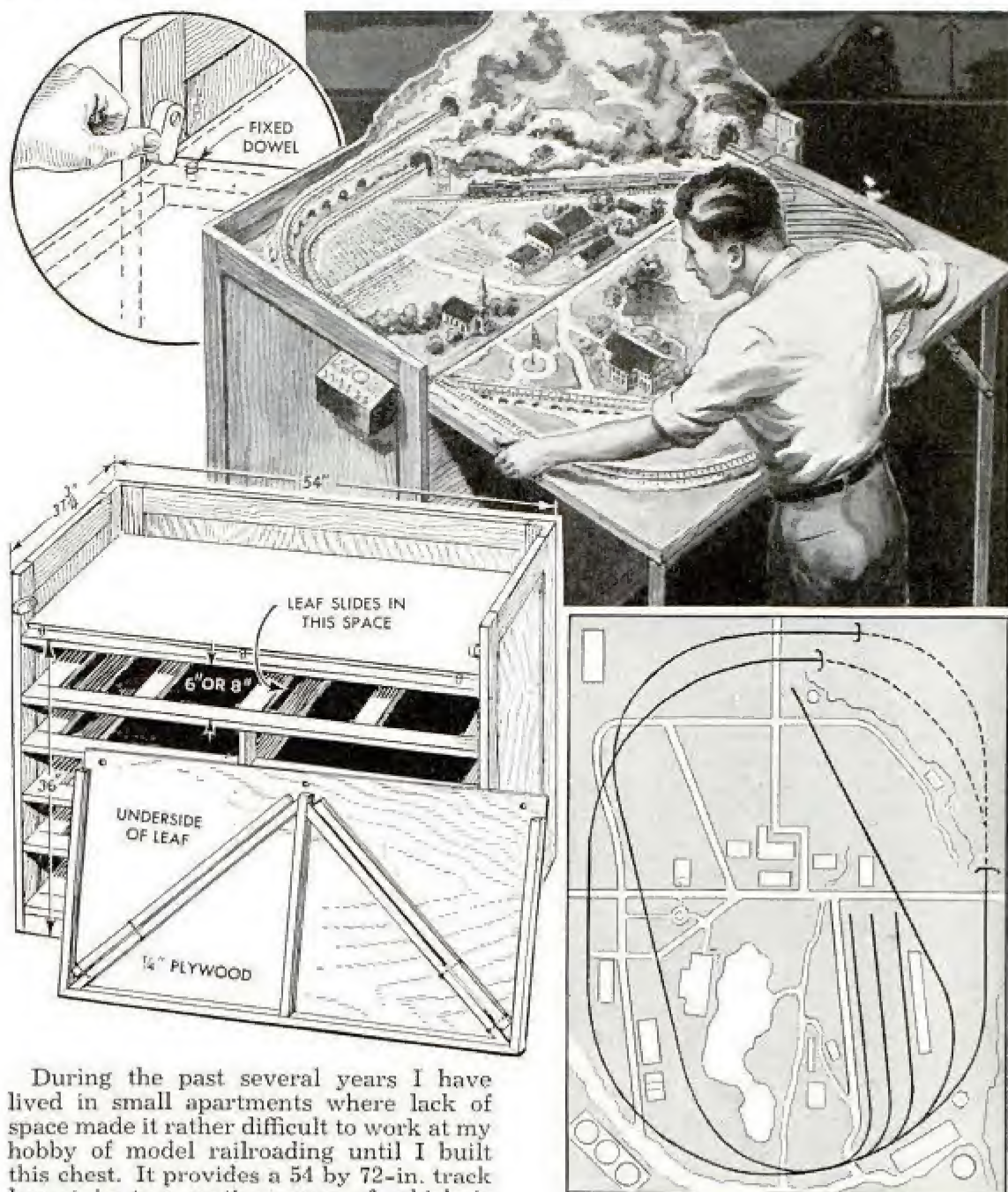
When applying either metal or plastic edging to built-in sink tops, one carpenter runs a line of calking compound into the corner of the edging as shown. When the edging is screwed in place, the compound spreads



One office worker who often had to staple large numbers of papers together did the job uniformly and saved time and labor by using a guide board like the one shown. It is made from 1-in. stock and is fitted with adjustable guide strips for holding the papers stacked uniformly. Three notches at one end permit slipping the stapling machine over the edges of the papers.



Model-Railroad Track Layout Built in a Chest

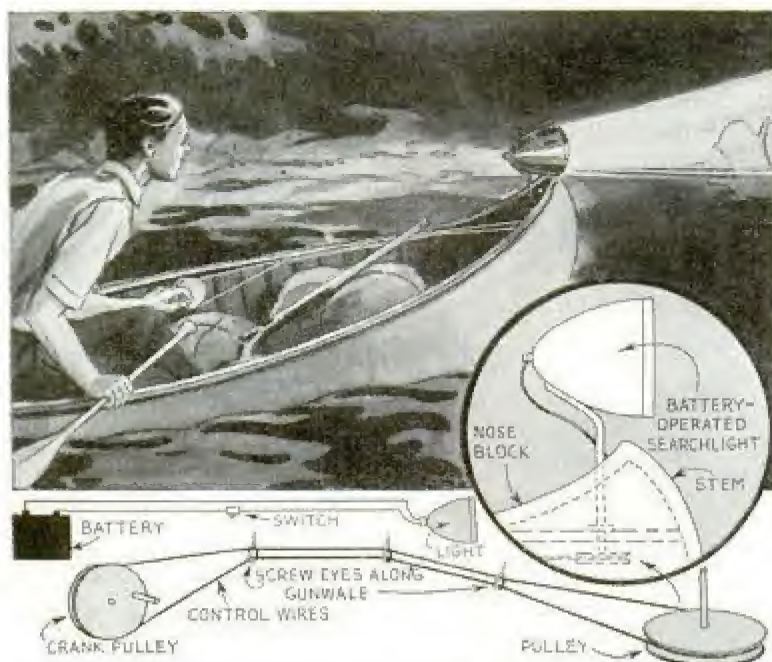


During the past several years I have lived in small apartments where lack of space made it rather difficult to work at my hobby of model railroading until I built this chest. It provides a 54 by 72-in. track layout in two sections, one of which is stored inside the chest when the equipment is not being used. The chest consists of a wooden frame paneled with $\frac{1}{4}$ -in. plywood or hard-pressed board. One section of the track and scenery is placed in a well at the top, and the other is built up on a leaf that can be removed and slid into a compartment under the well. The leaf has three holes spaced along one side to fit over three fixed dowels in the rabbeted edge of the well, and is supported at the outer edge by two folding legs from a card table, cam-like hold-downs being used at each corner

of the well to keep the leaf from slipping off the dowels. Shelves or drawers under the leaf-storage compartment provide storage space for rolling stock, tools and other equipment. Notice that all the high scenery, such as mountains, tunnels, etc., is built on the well section of the track layout, and the low scenery is built on the shelf section to avoid interference when slipping it into the storage compartment of the chest.

—Frank L. Wilson, New York City.

Canoe Searchlight Rotated by Turning a Crank



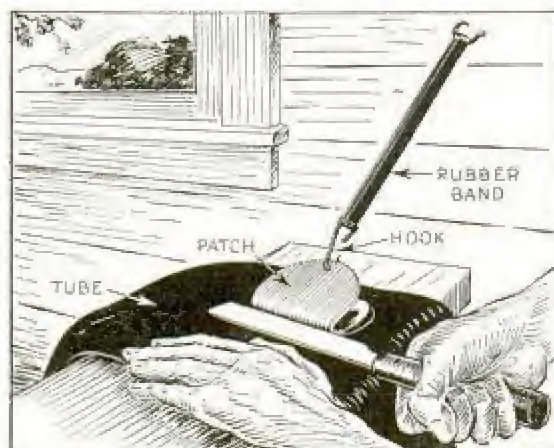
When canoeing at night, this searchlight, which can be rotated by means of a crank located within easy reach from the paddling position, enables you to observe the shore line without turning the canoe as would be the case if the light were stationary. Any auto headlight or spotlight can be used for the purpose, and is attached to a vertical shaft which passes through a hole drilled in the nose block of the canoe. The shaft also passes through a block fitted under the nose block, and is fitted with a collar attached with a setscrew to hold the shaft at the desired height. The lower detail shows the pulley-

and-crank arrangement by which the searchlight is turned, the rope passing through screweyes driven into the gunwale. A small storage battery is fastened to the canoe with clamps, which prevent losing it in case the canoe is upset, and a switch is located near the crank. The switch is cut in one of the lines leading from the battery to the light as can be seen in the circuit diagram.

—L. B. Robbins, Harwich, Mass.

Rubber Band Provides Tension To Remove Inner-Tube Patch

A tire repairman uses what he calls a "third hand" to aid in removing old repair patches from inner tubes. It consists of a stout rubber band and hook which are sus-

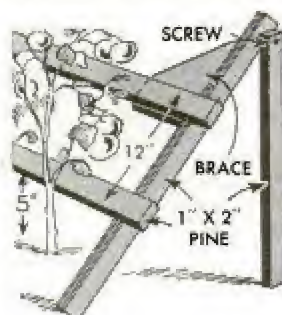


pended from the wall just above his tube-repair bench. As soon as one edge of the patch has been loosened, the hook is used to pull it back so that the operator can use both hands to hold the tube and cut it smoothly away with a knife.

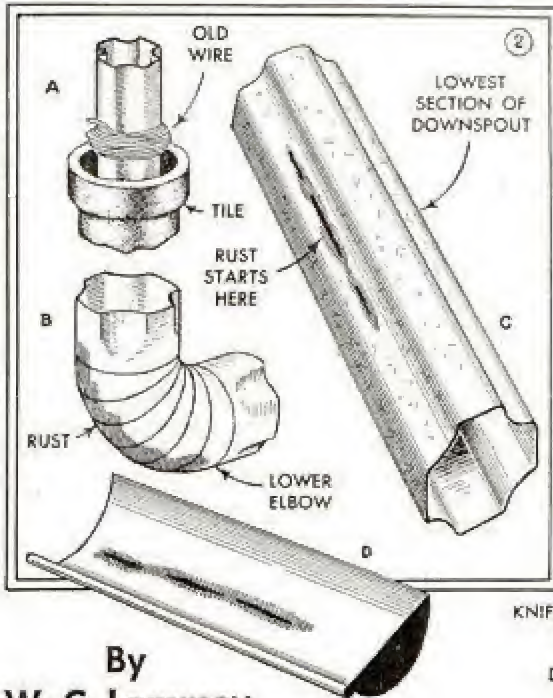
Adhesive tape can be removed easily by spreading over it a little oil of wintergreen, which penetrates the tape and loosens the adhesive.

Slanted Trellis Supports Tomatoes

To keep his tomato plants from sprawling over the ground, one gardener uses slanting trellises or racks like the one shown. This supports the plant above the damp ground throughout the growing season and makes the fruit more resistant to disease by allowing sunlight and air to reach it. The racks are 6 ft. long and each ordinarily supports two plants. Two legs, attached with screws so that they fold flat, support the trellis at an angle of about 40 degrees. The plants are tied over on the rack when they are about 15 in. high. Rows are run east and west and the racks are placed on the north side of the plants.



MAKE YOUR GUTTERS LAST



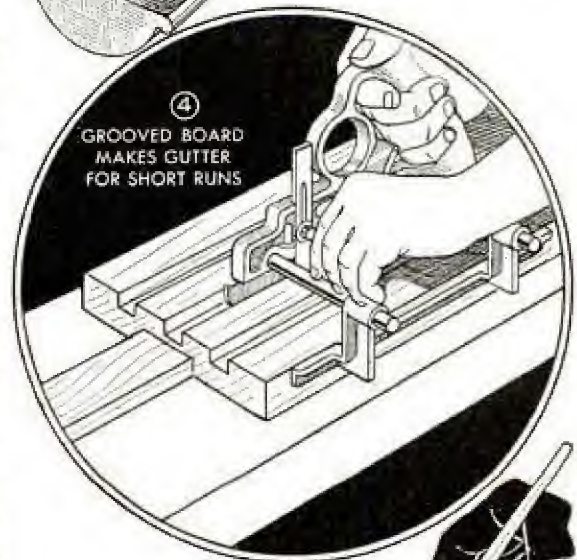
By
W. C. Lammey

BY REPAIRING the gutters on your home so they will last longer you are not only extending the life of these fittings, but of the house as well. Water running from a leaky gutter or down the siding washes away the grade around the foundation, seeps into the basement, causes undue settling with resultant cracks in plaster, sticking windows and doors, and warped roof and framing.

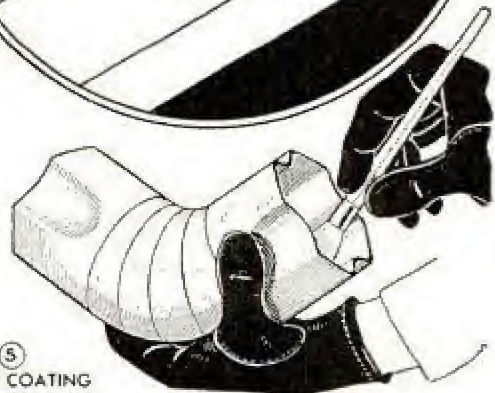
It's a good idea to check the whole gutter system with a level as in Fig. 1 and to correct any sags or low places that may have been caused by an overload of ice or a snowslide from the roof. If water stands at any point, it is only a matter of months until the metal is eaten away by rust. If you find low spots where rust has already appeared, or a leak has started, the gutter should be straightened and repaired immediately. Fig. 3 shows one effective way to stop a leak. First, coat the area over and about the leak with a knife-grade calking compound. Then cut a strip from smooth roll roofing and coat the back, or "down" side, with the same material. Press it into place and seal the edges as indicated. Build up the bottom of the gutter to the level of the patch with the compound so that water does not stand. If calking compound is not at hand, any liquid roof coating will serve as an adhesive.

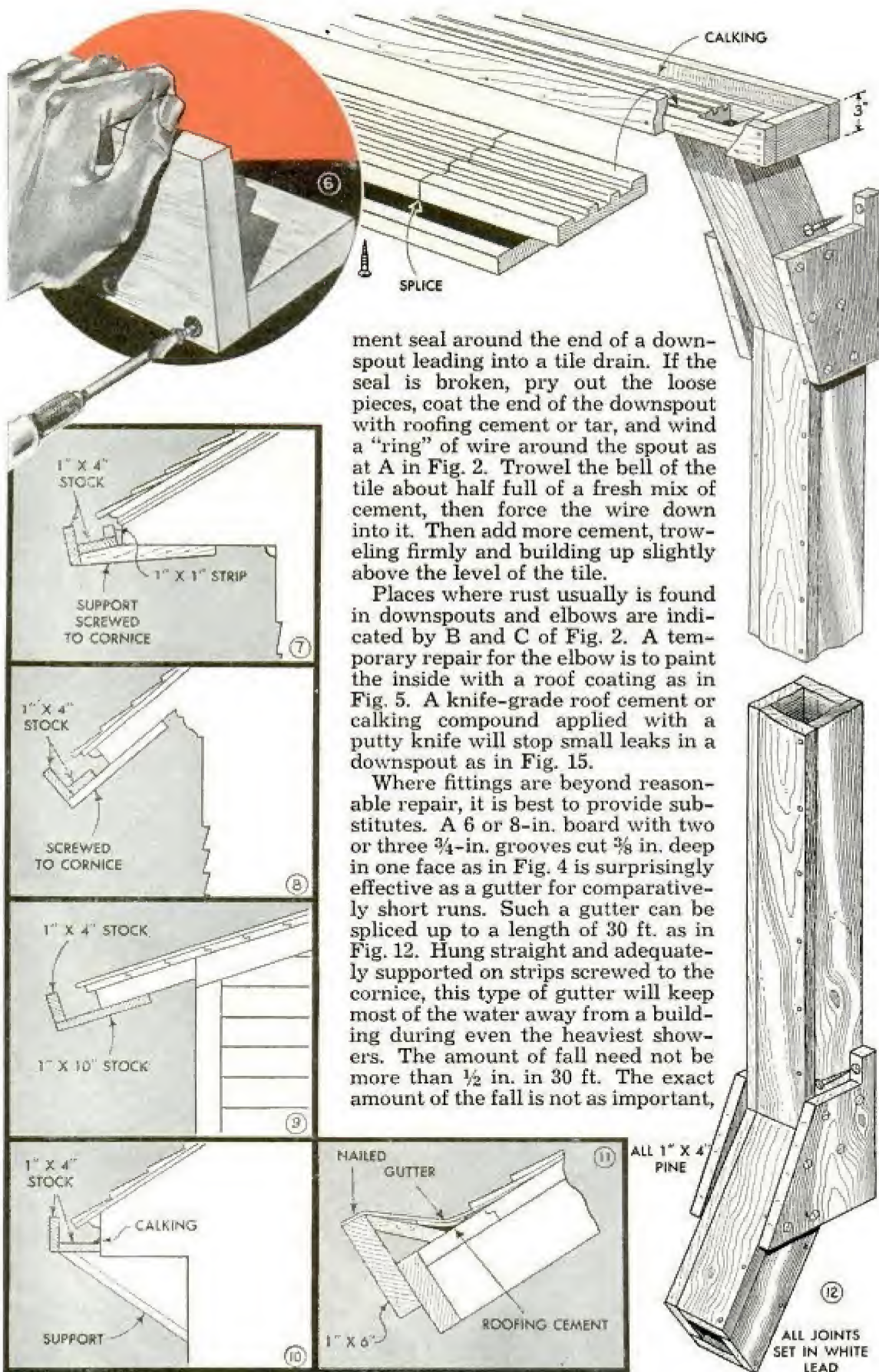
Another thing to note while you're going over the system is the condition of the ce-

KNIFE-GRADE CALKING COMPOUND
DIRECTION OF FALL
STRIP OF ROLL ROOFING



ROOF COATING
PROLONGS THE
LIFE OF ELBOWS

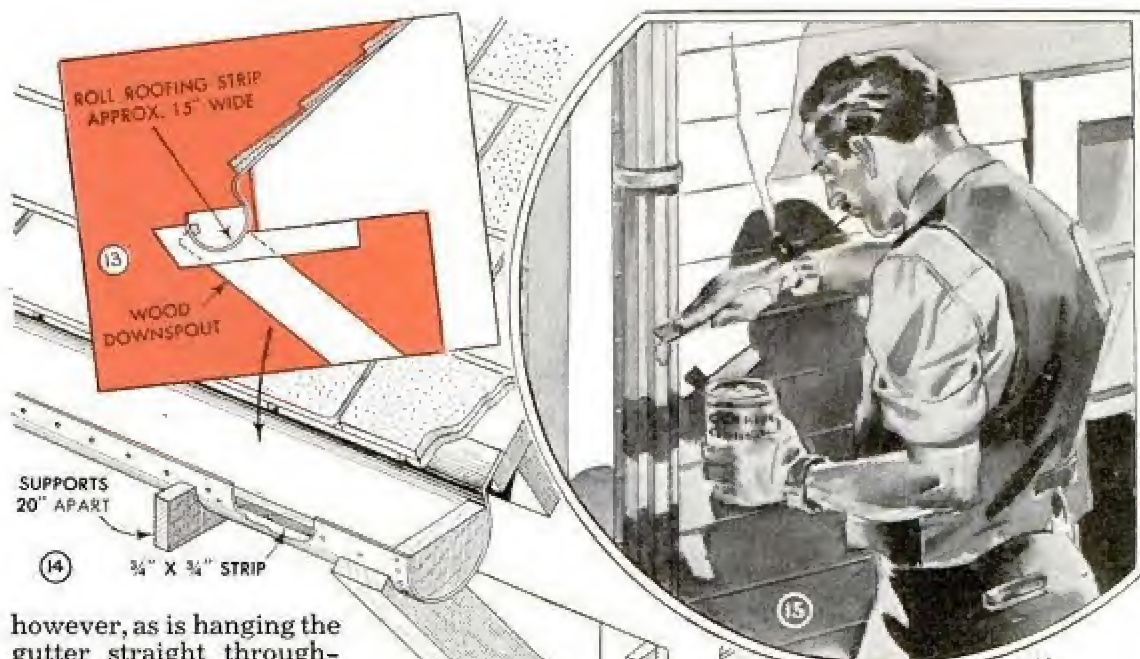




ment seal around the end of a downspout leading into a tile drain. If the seal is broken, pry out the loose pieces, coat the end of the downspout with roofing cement or tar, and wind a "ring" of wire around the spout as at A in Fig. 2. Trowel the bell of the tile about half full of a fresh mix of cement, then force the wire down into it. Then add more cement, troweling firmly and building up slightly above the level of the tile.

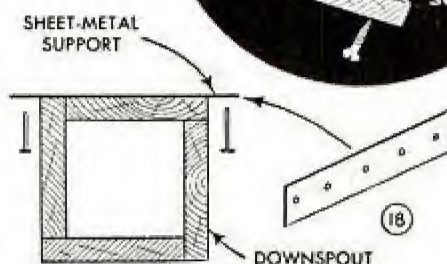
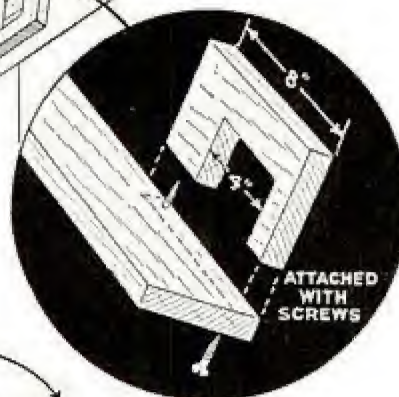
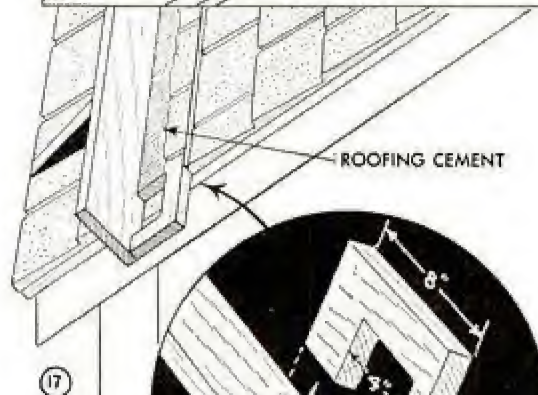
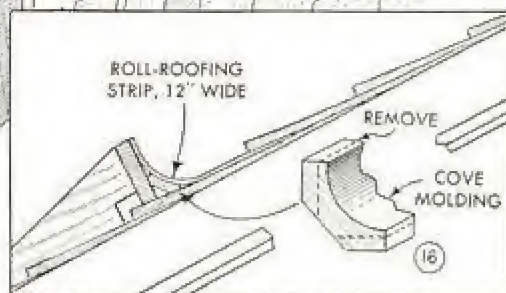
Places where rust usually is found in downspouts and elbows are indicated by B and C of Fig. 2. A temporary repair for the elbow is to paint the inside with a roof coating as in Fig. 5. A knife-grade roof cement or calking compound applied with a putty knife will stop small leaks in a downspout as in Fig. 15.

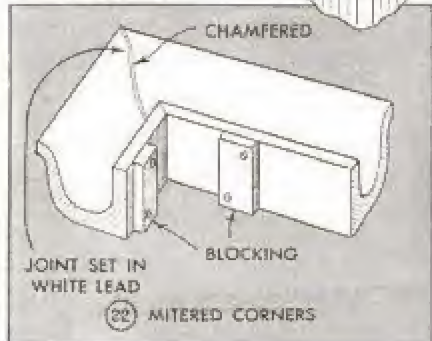
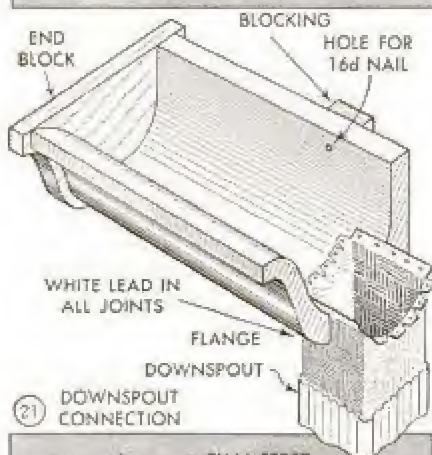
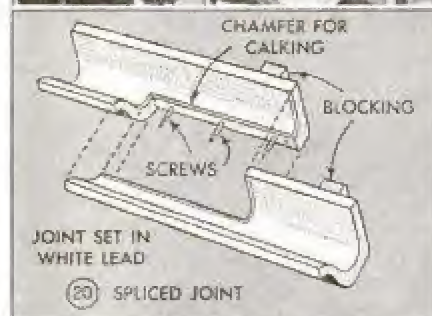
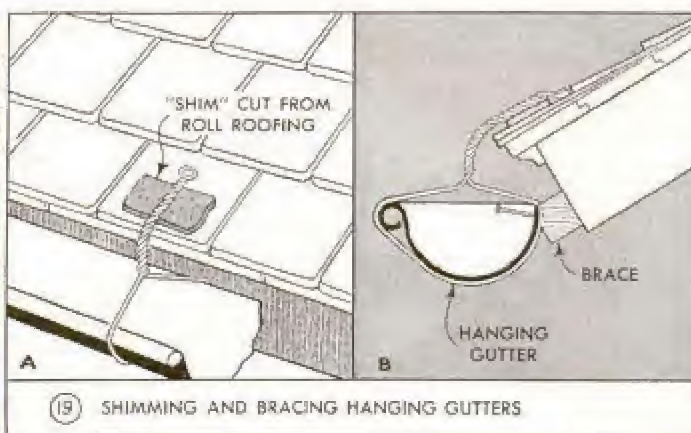
Where fittings are beyond reasonable repair, it is best to provide substitutes. A 6 or 8-in. board with two or three $\frac{3}{4}$ -in. grooves cut $\frac{3}{8}$ in. deep in one face as in Fig. 4 is surprisingly effective as a gutter for comparatively short runs. Such a gutter can be spliced up to a length of 30 ft. as in Fig. 12. Hung straight and adequately supported on strips screwed to the cornice, this type of gutter will keep most of the water away from a building during even the heaviest showers. The amount of fall need not be more than $\frac{1}{2}$ in. in 30 ft. The exact amount of the fall is not as important,



however, as is hanging the gutter straight throughout its length. When metal downspouts are beyond repair you can make good substitutes from 1 by 4-in. pine as in Fig. 12. Admittedly crude compared to regular fittings, they will conduct water away from the foundations until such time as regular downspouts are available. Details show how to make and attach them to the wall and gutter. No dimensions can be given as each installation must be cut to fit individually. Figs. 7 to 11 inclusive show various gutters made by screwing two 1 by 4-in. or 1 by 6-in. boards together as in Fig. 6, and the methods of hanging them on both open and boxed cornices. While these simple designs are recommended only as temporary substitutes, they are patterned after installations that have been used in the past. In making any of these installations, use white lead in all butt and angle joints and, as an added precaution, use gun-grade calking compound applied with a gun, in all corners. Of course, all parts should be painted at least two coats.

If there is a scarcity of lumber of the required dimensions, Figs. 13 and 14 show how a temporary gutter can be made from strips of roll roofing and a few scraps of lumber for braces, ends and supports. By cutting a square hole at one end, a wood downspout, made as in Fig. 12, can be fitted to the curve and nailed in place, using roofing cement in the joint. The upper edge of the roofing strip is forced under the first course of shingles. However, it can be nailed to the cornice face board just under the shingles. Put up with some care, such a gutter will last for a number of years, but is recommended only as a tem-





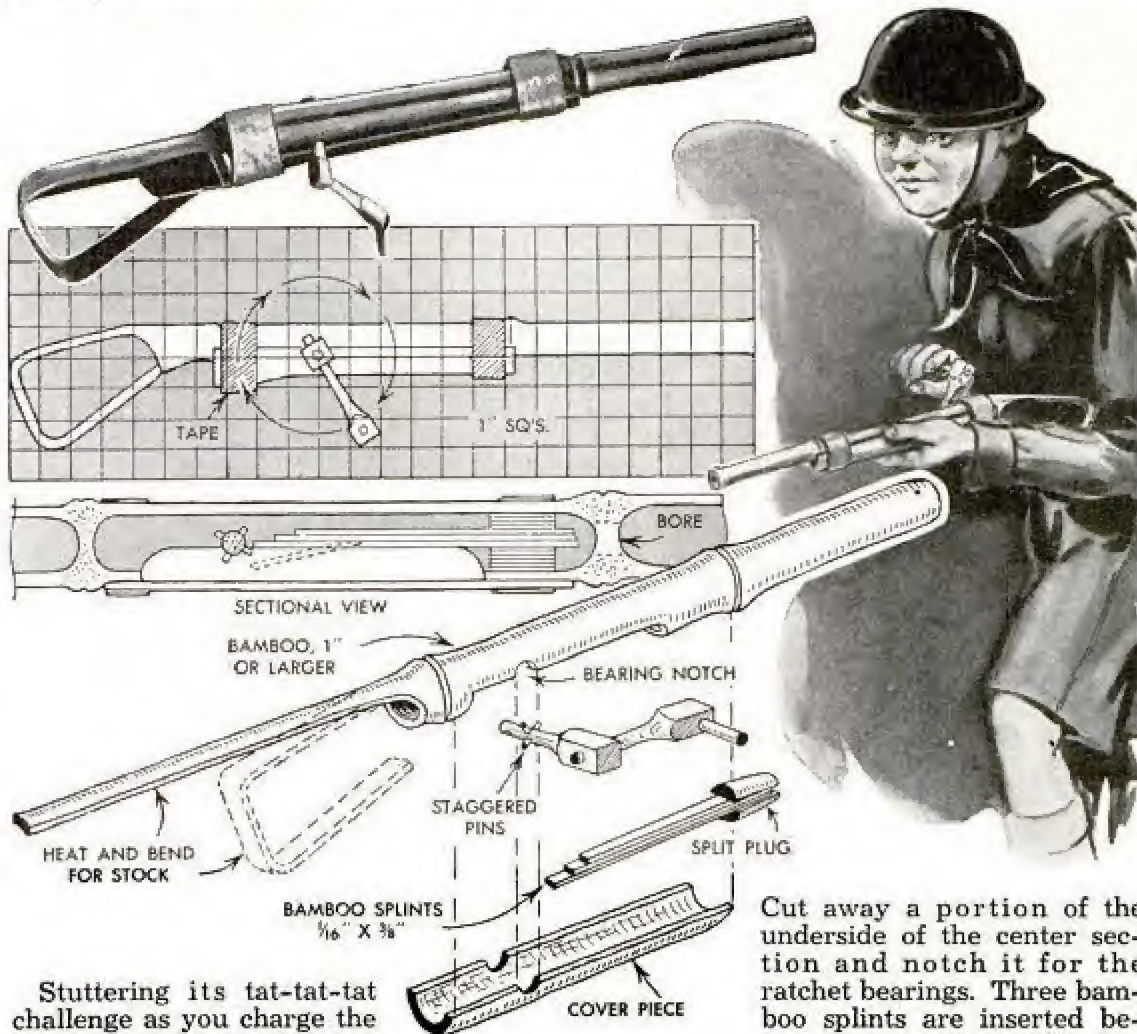
porary affair. Another one, shown Fig. 17, makes use of a single board set edgewise at right angles to the roof on the second course of shingles. It cannot be recommended for roofs of large area and steep slope as a snowslide or the collection of ice may break it away. Rather, it serves best on the lower-pitched roofs of outbuildings, garages and porches. Some fall is desirable

and is obtained by placing the board at an angle with the shingles. It is held in place with a number of braces notched over the shingle butts. The braces are nailed to the roof. Should the gutter be removed, the nail holes must be filled with roofing cement. The circular detail shows how to attach a wood downspout to the overhanging end. Figs. 11 and 16 show other variations of this type of gutter. In making these assemblies, where much depends on the tightness and strength of the joint, use screws if they are obtainable in any suitable size. Screws have the advantage that when you take down the assembly to replace it with regular fittings, you can do so easily without damaging either the materials or the building. Fig. 18 shows how small strips of sheet metal, if available, can be used as supports for long runs of wood downspouts, making a somewhat neater installation than the wood brackets shown in Fig. 12.

Figs. 20, 21 and 22 show recommended methods of making the necessary spliced joints, downspout connections and mitered corners of all wood gutters. The details show a common shape of the ready-made wood gutters and how they are blocked away from the cornice. Rectangular metal downspouts are generally used but where these are unobtainable a wood downspout can be installed temporarily.

Hanging metal gutters exposed to wind and winter ice begin to sag and swing loose in time. Generally this means that the nails holding the wire or strap hangers, especially the former, have loosened and the hangers are cutting into the shingles, allowing the gutter to sag in places and also to swing or vibrate in high winds. One way to remedy this trouble is to work a square of composition under each hanger and drive the nail in tight, as at A in Fig. 19. Hanging gutters which tend to sway in high winds can be braced as at B. Bevel a wood strip to suitable width and attach it to the cornice board with screws. Then drive nails through the gutter into the strip.

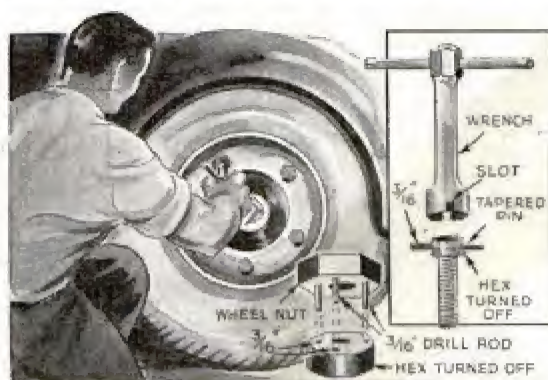
Play Machine Gun Produces Realistic Sound



Stuttering its tat-tat-tat challenge as you charge the enemy positions, this toy machine gun realistically produces the noise of battle desired by the junior soldier. To make it you will need a 2-ft. length of bamboo that is at least 1 in. in diameter and has the joints spaced not less than 8 in. apart. Trim one end for the stock, which is steamed and bent to the shape indicated.

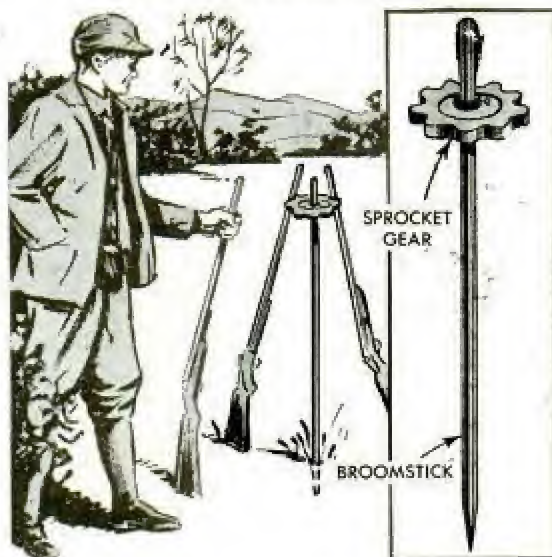
Cut away a portion of the underside of the center section and notch it for the ratchet bearings. Three bamboo splints are inserted between parts of a split plug, which then is forced into the forward end of the barrel. The splints are of varying lengths so that the ratchet engages only the longest one, the hollow barrel serving as a sounding box. Pins on the ratchet are pieces of a nail. A bamboo cover is taped over the opening beneath the mechanism.

Simple Way to Prevent Theft of Auto Tires and Wheels



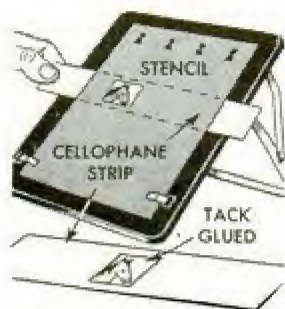
To prevent anyone from easily removing wheels and tires from my car, which has stud bolts instead of the usual bolts and nuts, I removed one stud bolt from each wheel, drilled a $\frac{3}{16}$ -in. hole through the head and then turned off the flat portions to make it round. When a wheel has to be removed, I slip a short pin into the hole and use a slotted wrench. For wheels with regular nuts, round one nut, then drill three holes in its face. To take off a wheel, use your regular wrench and a nut with three projecting pins to fit the holes in the round nut.—H. W. Stamper, Richmond, Va.

Sprocket Gear on Broomstick Used as Gun Stand



To keep trap-shooters' guns conveniently at hand, the manager of one club uses a discarded sprocket gear which is driven onto a length of broomstick. The stick is pointed so that it can be driven into the ground easily.

Pictures Shifted Under Stencil Without Loosening Edges



When small pictures are taken from catalogs or newspapers for use as illustrations on a duplicating stencil, the positioning of each one is frequently difficult as the stencil must be loosened and raised to shift

the pictures. To simplify this task, merely glue the pictures onto separate strips of Cellophane, which permits them to be inserted under the stencil and moved to any desired position without loosening the edges. Also, as the pictures are glued under the Cellophane, the tracing stylus cuts cleaner lines against this surface.

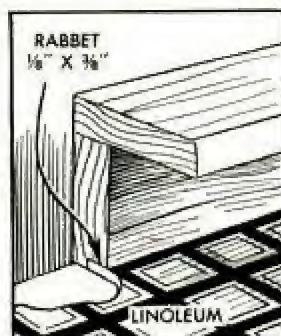
Painting Water-Softener Tanks

If you have a water-softening tank in your basement that is rusty and unsightly, its appearance can be improved by coating it with asphalt roof paint. This paint comes only in black, but this is much better than the encrusted, scaly appearance of a rusty tank. The salt brine used in cleaning the

filtering materials of the tank is very corrosive to metal and will destroy ordinary paints and enamels quickly. Even the rust inhibitive paints like red lead and iron oxide types that are effective in preventing rust on metals in most cases are unable to prevent rusting of the salt-coated softening tanks in basements where the air usually is very humid. Before applying the asphalt paint, clean the surface of the tank thoroughly, chipping off all rust scales and then going over the surface with a wire brush.—F. N. Vanderwalker, Flossmoor, Ill.

Toe Inset of Under-Sink Cabinet Rabbeted to Take Linoleum

When building in a cabinet for a sink be sure to rabbet the lower edge of the vertical member which forms a part of the toe inset at the front. This allows you to slip the floor covering under the edge, making a neat job without the necessity of nailing quarter round in a position where it is difficult not only to nail but to remove.



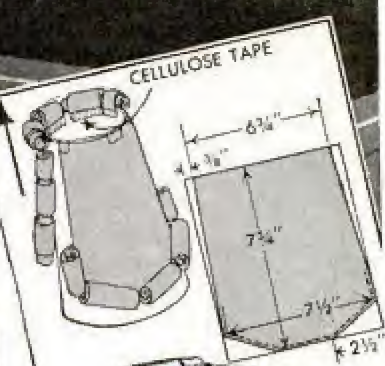
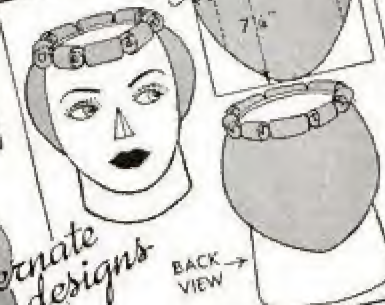
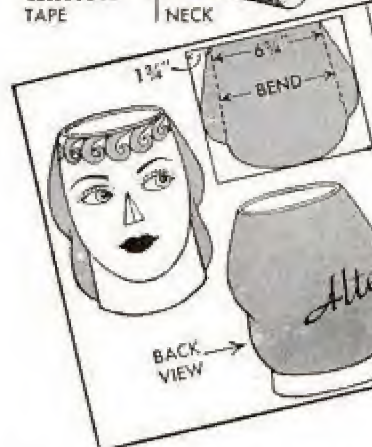
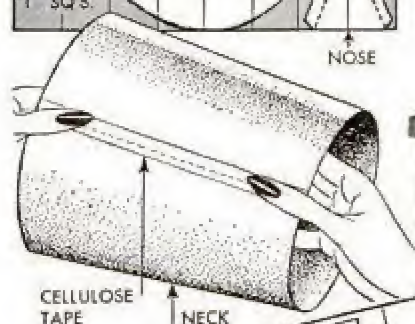
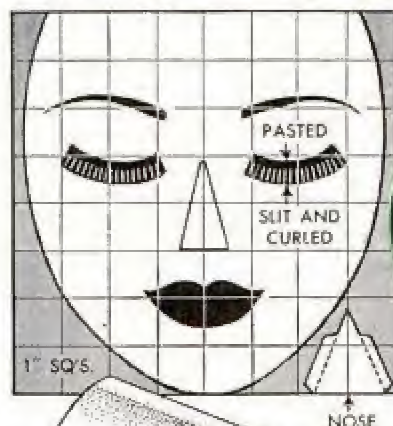
Letters Sealed With Nail Polish Cannot Be Steamed Open



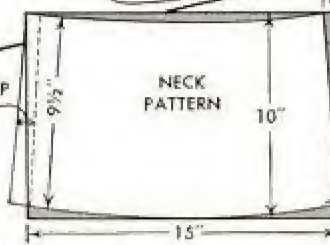
If you want to be sure that your letters cannot be opened by someone steaming them to soften the glue on the envelope, seal them with fingernail polish. This is moistureproof and no amount of steaming will soften it.

☛ Vaseline will prevent drawers from sticking if it is rubbed generously into the wood at the contacting points.

Paper-Head HAT STANDS



MADE entirely of tough light card-board and paper, these unusual hat stands have a lifelike appearance, even to the tresses and eyelashes. In all the designs, a piece of flesh-colored card-board is rolled to a slightly tapered cylinder to form the neck; then the face, of the same material, and the hair are attached to the neck with cellulose tape. The necks and the faces are all cut to the same size and shape, but the hair and features can be varied as indicated. Shiny black or brown paper is used for dark hair and light brown or gold paper for blond, although white-pine shavings make perfect platinum-blond curls. In assembling a head, the face is attached to the neck by a piece of tape across the top only. Then the hair



is fastened to the top at the back and the curls are attached to the underside of the hair and face pieces. Curls at the top of the head are fastened to the inside of the neck cylinder and are kept from unwinding by running cellulose tape through them. The nose is bent V-shaped so that it extends about 1/2 in. beyond the face, and the tabs are bent under and glued. The eyes and lips may either be painted on or cut from paper. Eyelashes are strips of paper slit along one edge and pasted in place, and then curled upward.

OUTDOOR



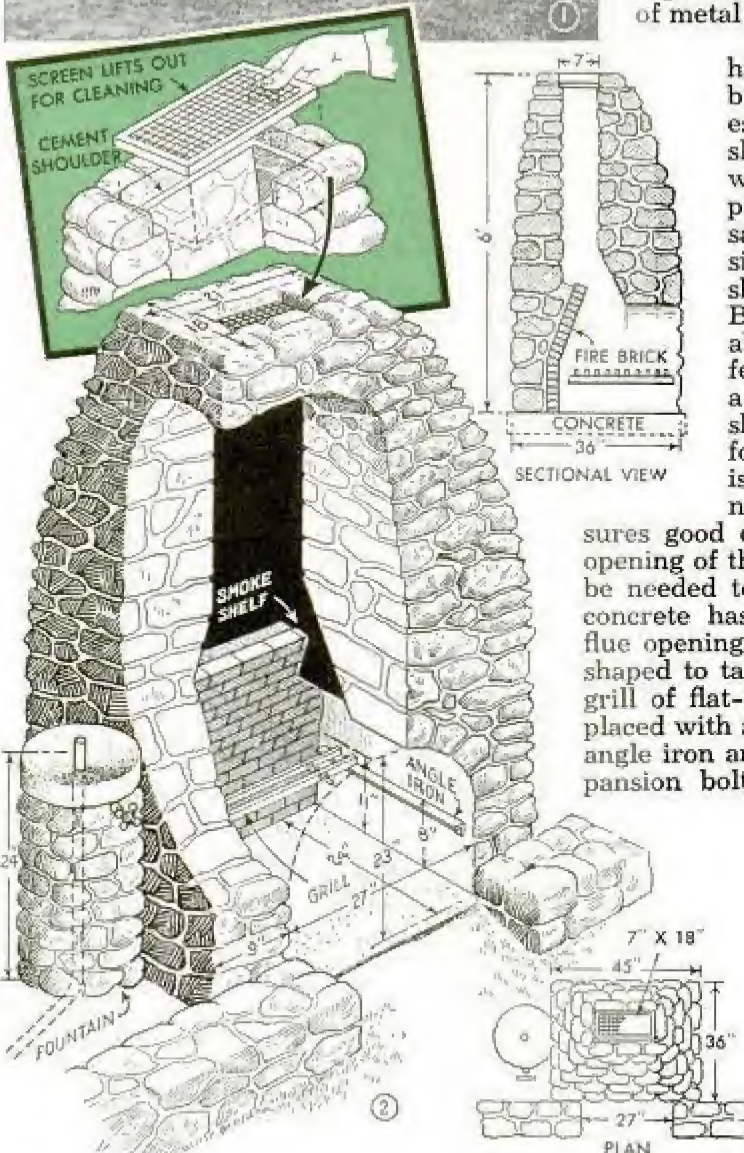
Three excellent designs—one incorporates a drinking fountain, another an incinerator. All can be built inexpensively of field stone and some old pipe, angle iron and sheet metal

IT'S LIKE having an extra room to have a fireplace in your yard. The added enjoyment and diversion that you get in preparing and serving meals outdoors brings restful relaxation from daily routine. Any one of these fireplaces can be built at little cost, using common field stone and resorting to the scrap pile for the few pieces of metal required.

The fireplace shown in Fig. 1 has the added feature of a built-in fountain. It looks especially well when built on a slight terrace, as the retaining wall of field stone appears as a part of the fireplace and at the same time provides a place to sit. The cutaway view in Fig. 2 shows the general construction. Besides the field stone and about half a sack of cement, a few firebrick will be needed for a fire wall, which is laid as shown in the sectional view to form a smoke shelf. The latter is recommended for tall chimneys such as this one and as-

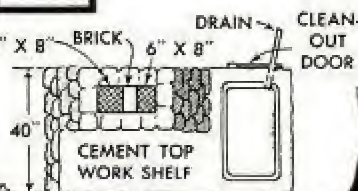
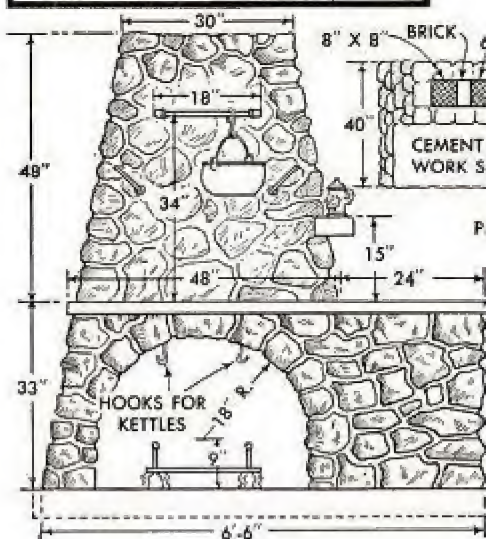
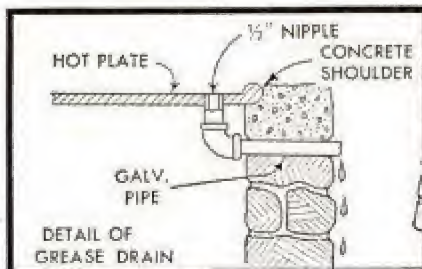
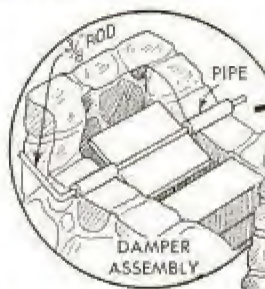
sure good draft. In forming the arched opening of the fire pit, a wooden form will be needed to support the stone until the concrete has hardened. Notice how the flue opening at the top of the chimney is shaped to take a lift-out spark screen. A grill of flat-iron strips which can be replaced with a hot plate, rests on lengths of angle iron anchored to the stone with expansion bolts. This is done by drilling holes in the stone and fitting them with threaded sleeves which expand when the bolts are drawn up tightly.

The fireplace shown in Fig. 3 incorporates an incinerator at one side over which a hot plate is located. Besides this, it has a rack across the front on which to hang kettles, a wide concrete work shelf and hooks in the fire pit for bean pots.

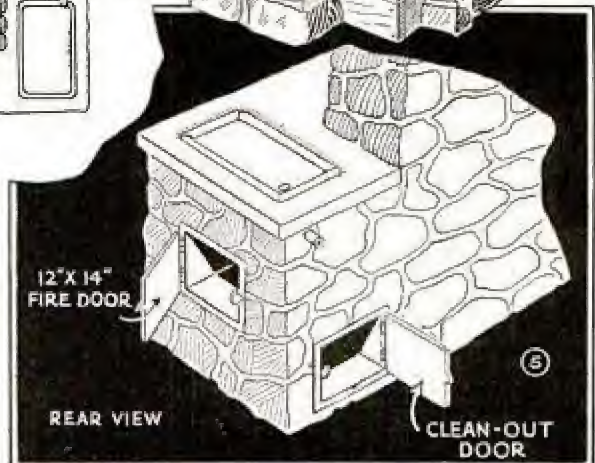


KITCHENS

Separate flues for the fire pit and the incinerator are fitted with dampers as indicated in the circular detail, and are capped with spark screens the same way as done before. The incinerator and the flue leading to it are built around wooden forms similar to the ones shown in the cutaway view in Fig. 4, after which the forms are knocked out before covering the top with concrete. As was the case in the first design, a wooden form will be needed here also, to support the arched opening of the fire pit. Note that the hot plate has a grease drain which extends out the back as shown in the detail to the left of Fig. 4. Old cast-iron stove doors can be utilized for the fire and clean-out openings of the incinerator. These, of



PLAN

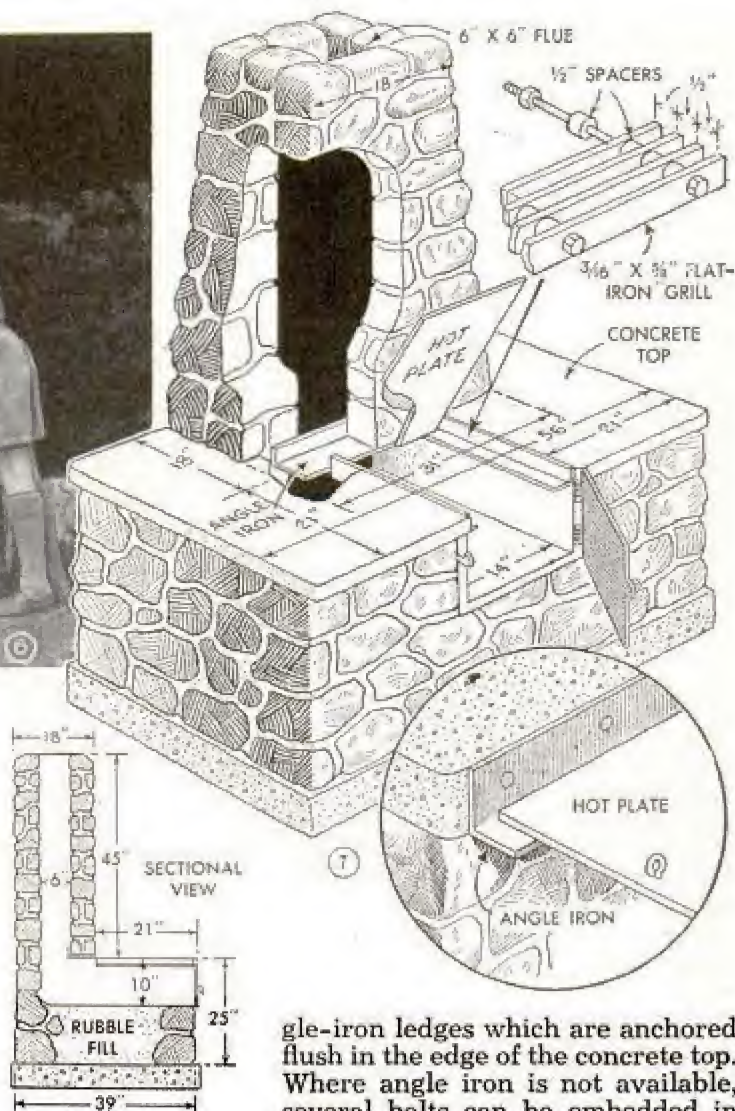


REAR VIEW



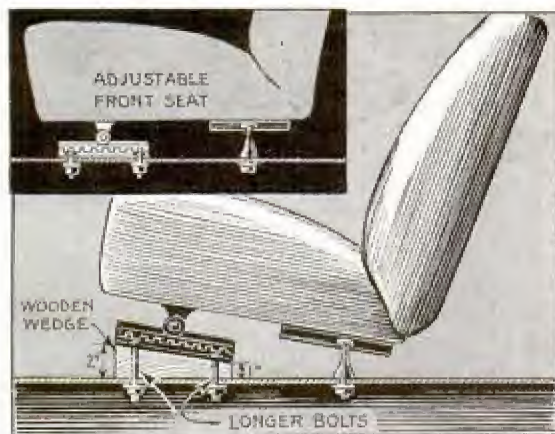
course, should be at hand before beginning work so that the size of the openings can be made to correspond. If stove doors or sheet steel cannot be found, suitable doors to serve the purpose temporarily can be shaped of slate shingles as shown in Fig. 5.

The third fireplace shown in Fig. 6 and detailed in Fig. 7, is built on a concrete base and its chimney is supported above the firebox by a piece of heavy angle iron. Stone can be conserved by filling in the center portion below the firebox with concrete as indicated in the sectional view. The interchangeable hot plate and grill rest on an-

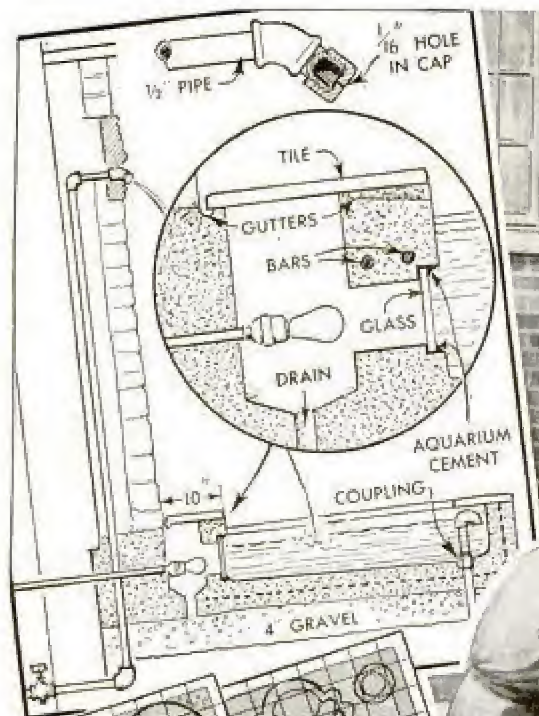


gle-iron ledges which are anchored flush in the edge of the concrete top. Where angle iron is not available, several bolts can be embedded in the edge of the concrete when it is poured so that they extend to support the plate or grill. The latter is built up of strips of flat iron which are drilled at the ends and center to slip over $\frac{1}{4}$ -in. rods.

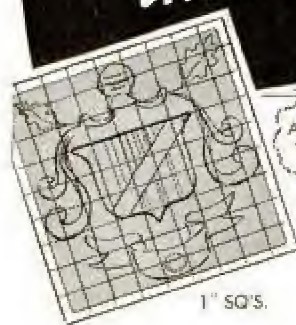
Raising Driver's Seat Gives Better Vision Ahead of Car



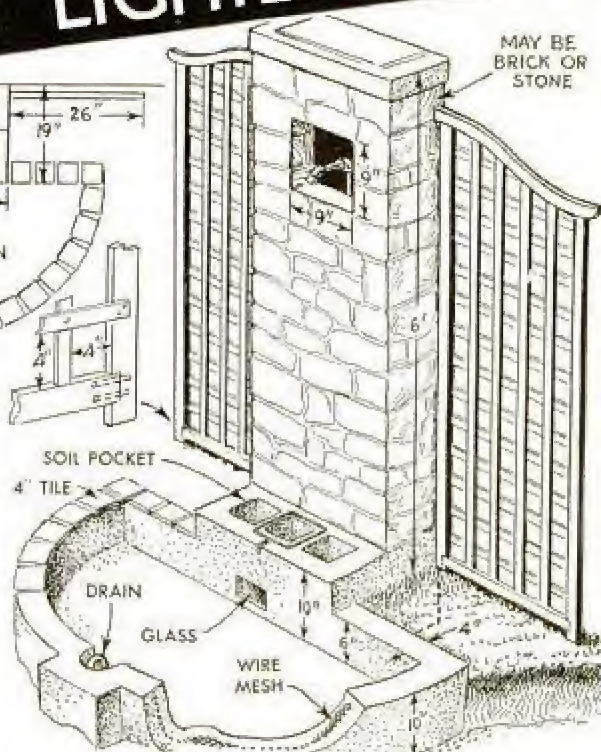
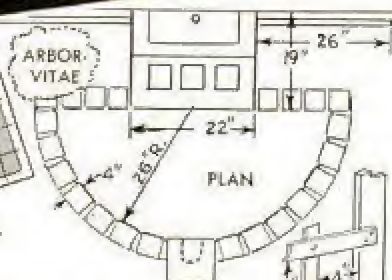
In order to see the road better ahead of his car and also to adjust the angle of the driver's seat more to his liking, one motorist raised the front of the seat. To do this, wedged-shape blocks were bolted under the seat tracks as indicated, making the front ends of the wedges 2 in. thick and the rear ends 1 in. thick. In this way, the angle of the track changes the angle of the seat as the latter is moved forward. On long trips, shifting the seat backward or forward at intervals tends to reduce tiredness from sitting in one position. Temporary blocks placed under a seat for a week or two permit drivers to determine the changes that afford the greatest driving comfort.



Unusual WALL FOUNTAIN and LIGHTED POOL



1" SQ'S.



Producing a striking decorative effect against the side of your home or garage, this unusual fountain and illuminated pool, enhanced by arborvitae and other shrubs, can be built at little cost. Stone or old brick, painted white, is used for the center column which conceals the water pipe. Excavation for the pool should be about 14 in. deep so that a 4-in. bed of gravel or cinders can be placed under the concrete to prevent damage during winter by heaving of the earth. The overflow pipe is installed to drain into the sewer. It is important that the bottom and sides of the pool be poured as one unit to prevent a joint where they meet. The gargoyle or fountain head may be cast of cement in a plaster-of-Paris mold taken from a clay model

Tent Flies Held Open or Closed With Fishline Sinkers

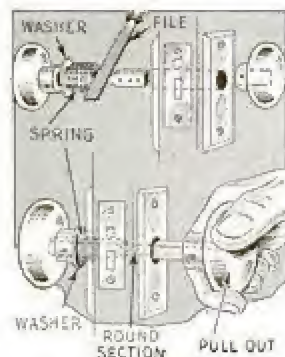


Flies of a tent can be kept opened or closed by using heavy fishline sinkers, which are attached to the corners with large safety pins. If sinkers of sufficient weight are not available, small tobacco sacks filled with sand will serve.

Avoid the Use of Blotting Paper On Legal Documents

According to the U. S. Bureau of Standards, blotters never should be used to dry signatures on important legal documents and state papers. Removing of the ink by blotting shortens the life of the writing. When signatures are required to remain legible for many years, the ink should be allowed to soak into the paper and dry.

Altering Common Door Latch To Make Secret Lock



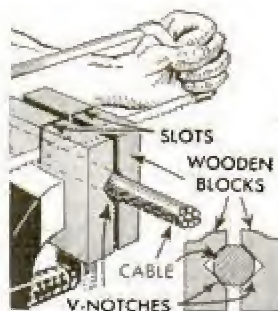
Here is a simple method of altering a common rim or mortise door latch to convert it to a secret lock. First, set the knobs as far apart as possible on their shaft and put a coil spring behind the one on the inner surface of the door. Then determine the portion of the knob shaft that is inside the bolt lever and file this portion round so that it will turn inside the squared lever. In this way, anyone not knowing the

secret will turn the knob on the outside but the latch will not work. However, when you pull on the knob to bring the squared section of the shaft into the bolt lever the latch will work.

secret will turn the knob on the outside but the latch will not work. However, when you pull on the knob to bring the squared section of the shaft into the bolt lever the latch will work.

Simple Method of Holding Cable To Cut It With a Hacksaw

A length of cable can be cut easily with a hacksaw by clamping it in a vise as shown. Two hardwood blocks having V-grooves cut in their centers are placed between vise jaws to aid in gripping the cable.



Wet Tires Marked With Talcum

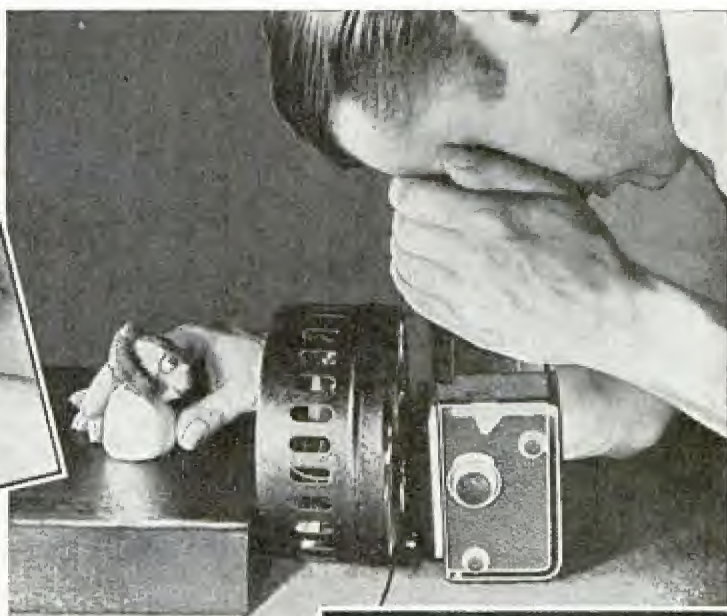


Annoyed by the difficulty of making legible marks on wet tires of cars to check their parking time, a police officer employed a sifter tube of tire talcum. This was attached to the end of a cane or stick by means of a stout rubber band and is used as a mallet to mark the side of a tire quickly without stooping.

Peening Repairs Stripped Threads In Aluminum Cylinder Head

When the threads in the spark-plug hole of an aluminum cylinder head had been stripped and there were no tools available for reaming and retapping the hole, an emergency repair was made by peening the upper part of the hole slightly with a punch and hammer. One man held the head on a block of metal, while another did the peening.—C. E. Packer, Chicago.

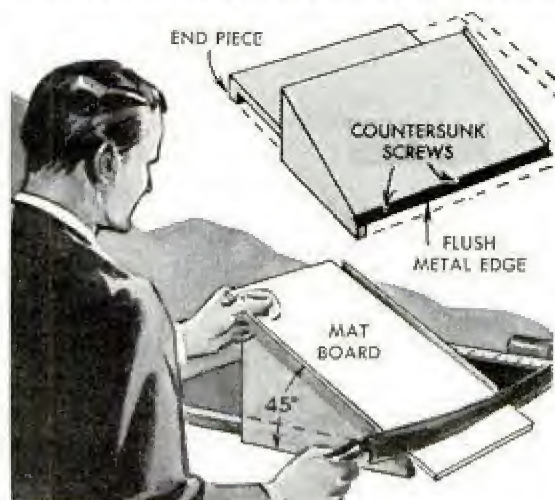
Photos of Small Objects Made With Any Camera



Owners of cameras not fitted with double-extension bellows can take closeup photographs of small subjects by placing a condenser lens in front of the camera lens. If your enlarger has condenser lenses, one of these can be used or you can purchase a secondhand condenser at a photographic supply store. The camera lens is placed in direct contact with the condenser lens, and the subject is placed about 4 in. in front of the latter. For best results the camera must be placed so the axis of its lens coincides with the axis of the condenser lens. By moving the subject and focusing the camera while watching the image on the ground glass, the sharpest point of focus can be found. After focusing, the camera lens is stopped down to its smallest aperture for greatest depth and detail. Photos of small objects, such as the 1½-in. glass figure illustrated, and the carved head, can be reproduced in considerable detail when enlarged.



Trimmer Attachment Gives Photo Mounts Beveled Edges



Edges of small pieces of mat board on which photographs are to be mounted, but which are not to be placed in frames, can be given a neat appearance by using this attachment to bevel them on your regular paper trimmer. Made from scrap material, the dimensions of the attachment will depend upon the size of your trimmer. The base, which rests on the cutting table of the trimmer, has a strip extending below it at the back to keep the unit from sliding forward as the cut is made and one of the triangular side pieces also extends downward so it cannot slide toward the back of the trimming board. A strip of metal fastened to the cutting edge of the attachment with countersunk screws must line up exactly with the cutting edge of the trimmer.

Rubber Cement on Paper Cutter Provides Nonslip Surface



Photographic prints, especially large ones, will not be so apt to slip while they are being trimmed if you apply rubber cement to the trimming board as shown. A strip about $\frac{1}{2}$ in. wide is sufficient.

Roll Films Washed Under Shower

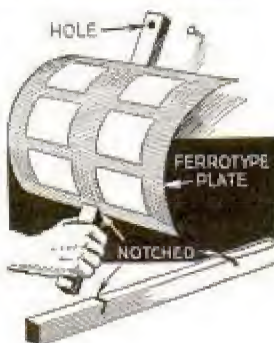


Roll films will wash rapidly and thoroughly if they are suspended under a shower spray, as shown. A piece of spring wire is bent to form a holder for a paper clamp, the two ends of the wire fitting in two holes of the shower spray. Adjust

the water so that a gentle steady stream flows smoothly over both sides of the film.

Ferrotypes Tin on Notched Stick Hangs on Wall While Drying

Ferrotypes tins are kept out of the way and held in a curved position while prints are drying by placing each tin on a notched stick and hanging it on the wall. The notches in the stick are cut at opposite angles slightly closer to-



gether than the width of the tin to be placed in them. A hole in one end of the stick allows it to be hung on a nail in the wall while the prints dry.

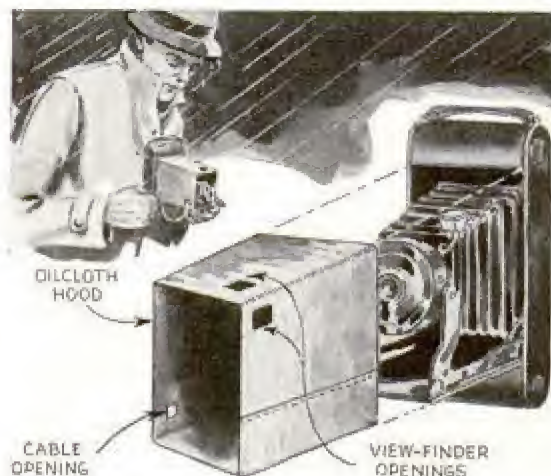
Transparent "Squeegee" Plates

I have found that celluloid sheets, obtainable at most hardware stores, make satisfactory ferrotypes "tins" for drying glossy prints. The prints come off the sheets with an even glossy surface and, if the sheet is rolled into a cylinder with the prints on the inside, the backward curve minimizes curling of the paper. An added advantage is that the face of the prints can be seen while they are drying.

—C. C. Casswell, Clarinda, Iowa.

Rainproof "Jacket" for Camera Protects Bellows and Lens

You can use your camera in bad weather with little chance of it being damaged if you make a protective hood to fit over the



bellows and extend slightly to protect the lens. Use oilcloth, Pliofilm or oiled silk, cutting it to the correct size and fastening the seam by sewing or with cellulose tape. A small opening is made for the cable release and, if opaque material is used, two other openings will have to be cut in order to use the view finder.

Cutting Lines on Process Film

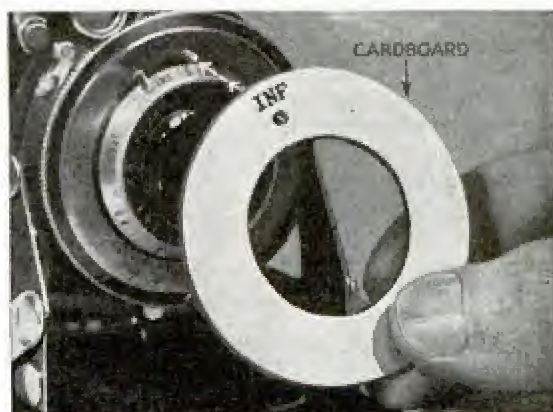
Cutting operations on lines or letters on process film can be made easier and the job can be done faster if the emulsion is moistened slightly. Use a moist cotton swab, rubbing it over the lines or letters to be cut out. This softens the emulsion slightly, enabling you to use less pressure with the cutting needle.

—Staff Sgt. Albert Bohm, Ft. Belvoir, Va.

Direct Focusing Guide for a Folding Camera



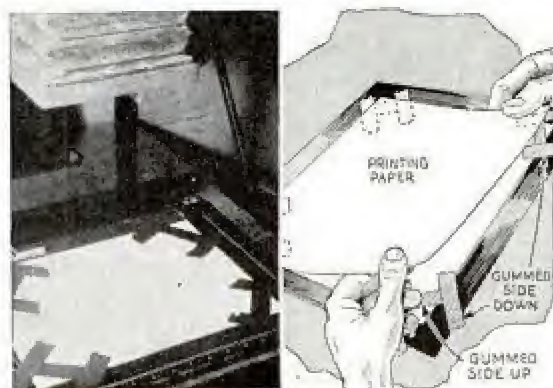
Fitted on any folding camera which is focused by rotating the front lens element, a cardboard focusing ring makes it possible to set the distance scale without removing the camera from eye level as the scale can be read on the back of the ring. The ring which fits tightly over the front lens mounting, extends beyond it. A small hole is punched in the ring, this always being placed over the infinity mark. The footage numbers are lettered on the back of the ring in their proper order and spacing. With the camera shown, the setting mark was made on a convenient rivet. After the ring is completed, it should be given a coat of clear lacquer.



Tape Holds Paper on Easel for Borderless Enlargements

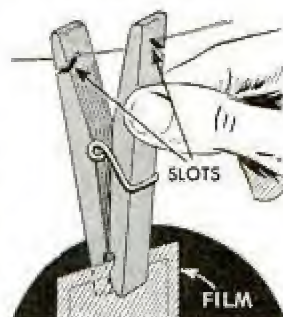
Enlargements without borders can be made easily on your regular enlarging easel by using strips of cellulose tape to hold the paper flat. After raising the hold-down strips of the easel, four pieces of tape with the gummed sides up are fastened to the easel with other strips of tape, as shown. The strips are so placed that one

strip will come under each corner of the size of paper to be used. The easel is positioned so the regular paper guides can be used and the paper is pressed against the tacky side of the tape at each corner. This will hold it flat while the exposure is made, after which it can be pulled off easily.



Safety Film-Drying Clips

Ordinary clothespins with slots sawed in each leg from opposite directions will hold films safely on a line while drying. There is no danger of the pins slipping off if the line is jerked accidentally.

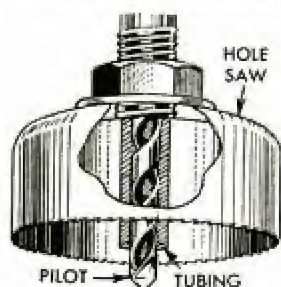


Cut-Off Gauge on Your Jigsaw To Handle Round Work



It's no problem to cut round work squarely on a jigsaw if you use a simple cut-off gauge like the one shown. It consists of three pieces of wood screwed together as shown so that the two end pieces rest squarely against the sides of the saw table, and serve as guides for the gauge. In assembling the gauge, the important thing is to be sure that the cross piece is assembled at right angles to the end pieces.

Simple Ejector for a Hole Saw



Trouble often experienced with a hole saw by having the disk cut from the work stick to the pilot and saw teeth can be avoided by using an ejector like the one shown. It is merely a piece of gum-rubber tubing slipped over the pilot and long enough to extend about $\frac{3}{8}$ in. below the pilot. In use the tube is compressed as the saw cuts through the work and forces off the disk after the cut has been made.—D. J. White, Hollywood, Calif.

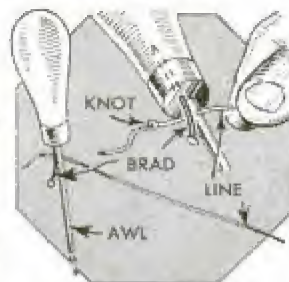
Homemade Friction Tape

If you are unable to obtain friction tape, a good substitute can be made by melting old inner tube rubber and brushing it onto cloth. To do this, cut the rubber into small pieces and melt it in a container over a low flame. Then mix the melted rubber with an equal amount of gasoline. After apply-

ing the mixture to strips of cloth, the gasoline soon evaporates, leaving the cloth with a sticky rubber coating. I have used this tape for the same purposes that I would use regular friction tape and find it satisfactory. A masking tape for painting can be made by coating heavy paper with the mixture.—A. H. Waychoff, Phoenix, Ariz.

Brad Awl Makes Handy Anchor At End of Measuring Line

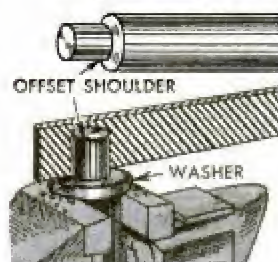
To anchor the end of a measuring line or plumb line, just drive a small finishing nail into the handle of your bradawl as shown. The knotted end of the line can then be wedged in the angle provided, thus making it unnecessary to tie a new knot each time the line is used. Also, the tool can be forced into the ground or soft wood quickly.



Increasing Life of Lamp Cords

When the rubber covering of a floor-lamp cord shows signs of deterioration, change it end for end in the lamp. As the length of wire protected within the lamp standard is approximately equal to the length of the exposed wire outside the lamp, reversing the wire brings an entirely new portion into use. Before making the change, however, all broken parts of the rubber insulation should be taped carefully, and care should be taken to see that the same worn and chafed portions are not exposed where the wire enters the lamp base.

Offset Shoulders Filed on Shafts By Using Washer as Guide



A good job of filing offset shoulders on a shaft or pin can be done very easily by using a loose washer as a guide for the edge of the file. This is accomplished by clamping the shaft in a vise vertically and then slipping the washer over the end of it so that the portion of work to be filed projects above the washer. With such a setup, the improvised guide also serves the additional purpose of protecting vise jaws.

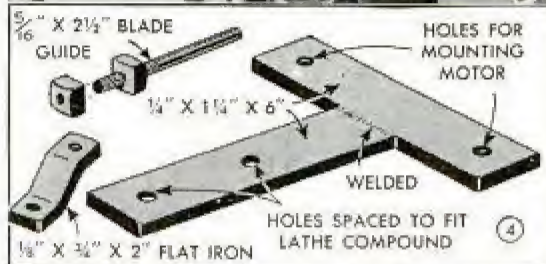
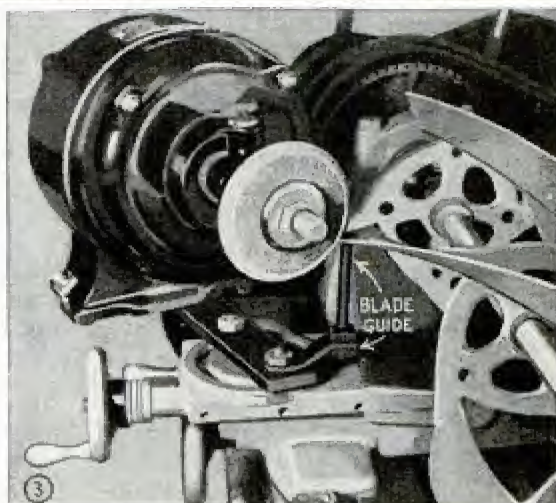


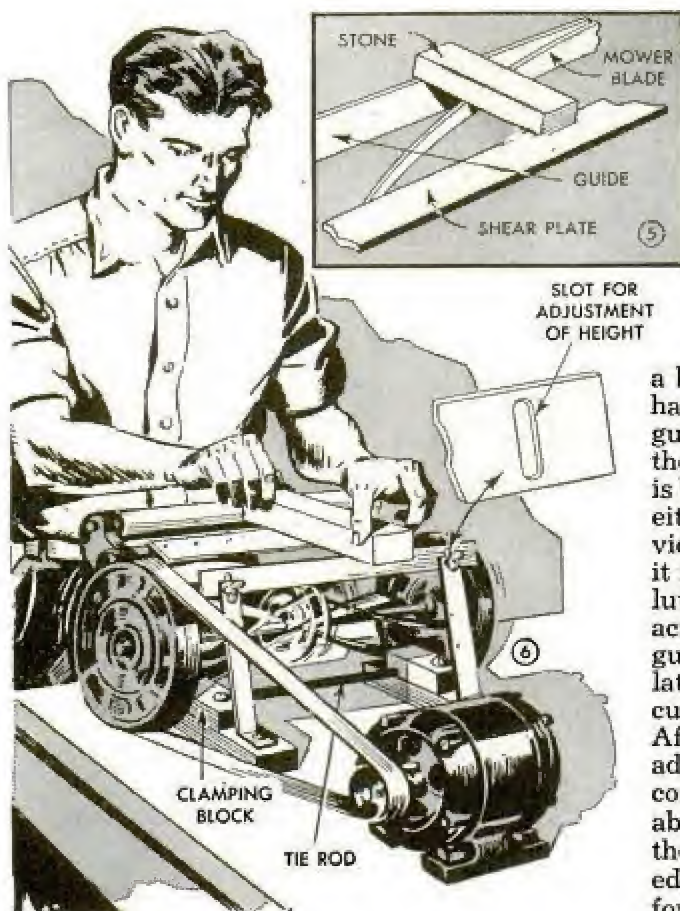
SHOP NOTES

Ways to Sharpen the LAWNMOWER



LAWNMOWER sharpening can be done profitably in any small shop or garage if a metal-turning lathe and tool-post grinder are available. The latter may be improvised from a motor on which a grinding wheel can be attached plus a few fittings to permit it to be bolted in an adjustable manner on the lathe carriage as shown in Figs. 1, 2 and 3. The fittings used are shown in Fig. 4. Remove the lathe centers and insert the shaft ends of the lawnmower blade reel into the center holes of the lathe head and tailstock so that it floats between them. Next, adjust the grinder so that the latter contacts the cutting edge of blade at right angles, and set the blade guide on the T-shaped iron as in Fig. 3 to hold the blade in this position. Now, start the grinder and the lathe and put the carriage in gear. As the grinding wheel travels along, it grinds the blade quickly and accurately, the guide keeping the blade in the correct position in relation to the grind-





ing wheel. To sharpen the shear plate of the mower, it is mounted in the lathe as in Fig. 1 and the grinding wheel is run over the blade by manual operation of the lathe carriage.

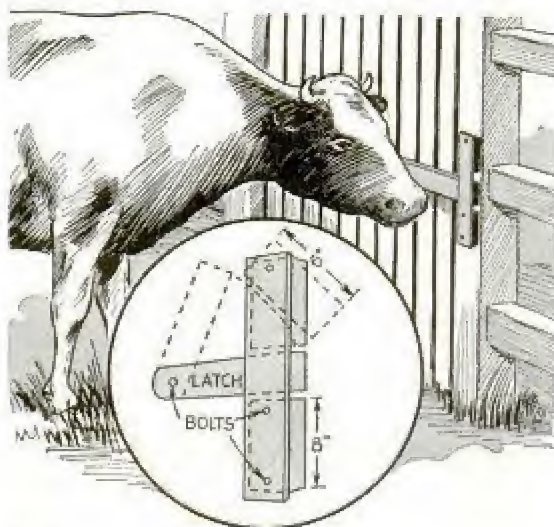
When a lathe is unavailable, you can do a fairly accurate job of sharpening a mower by belting it to an electric motor and using a hand stone as shown in Fig. 6. Clamping blocks to take the mower tie rod are screwed to a bench so that the end of the mower handle will rest on the floor. Then, a guide bar for the stone is screwed to the blocks, and a small electric motor is belted to one of the wheels. It is best either to gear down the motor or provide a resistance in the circuit so that it rotates about a hundred or so revolutions a minute. In use, hold a stone across the mower shear plate and the guide bar as in Fig. 5, adjusting the latter so that the stone just touches the cutting blades, then, start the motor. After the blades have been trued up, adjust the shear plate against them correctly and rotate the mower for about 10 min., applying plenty of oil to the plate. This will smooth the cutting edges, after which the mower is ready for use.

Latch for Barnyard Gate Can't Be Opened by Animals

If you have a cow or horse that is in the habit of opening barnyard gates, here's a simple latch that will prevent the trouble. It requires only a few minutes to assemble and consists of a pivoted arm which drops into a slot formed by bolting a block of wood and narrow board to the gate post. A pivoted block also is installed at the top of the vertical strip. This keeps animals

from raising the latch as it cannot be lifted unless the block is swung to one side as indicated by the dotted lines shown in the circular detail.

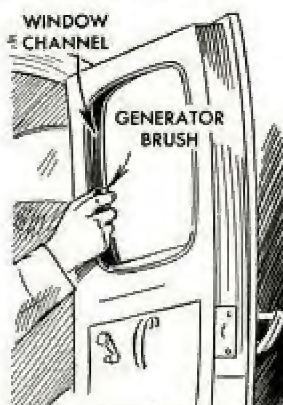
—George Spreier, Lincoln, Nebr.



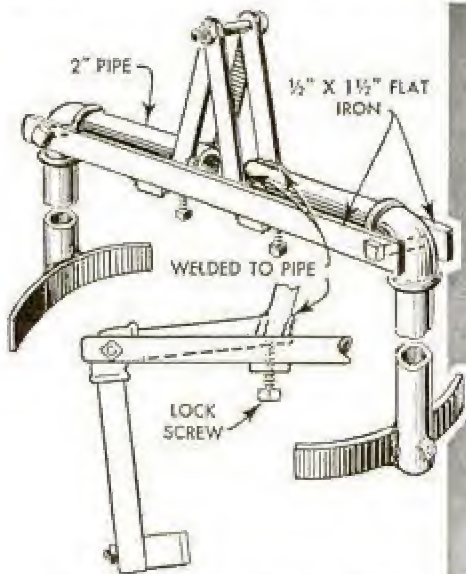
Car Door Windows Lubricated With Generator Brushes

When a window in your car sticks so that it is difficult to raise or lower, the trouble may be caused by the glass rubbing against the felt-covered slides. In most cases, this trouble can be eliminated by rubbing the inner surfaces of the slides with an old generator brush.

These brushes contain a large amount of graphite, which acts as a lubricant between the glass and slide.



Timesaving Clamp for Hoisting Large Drums



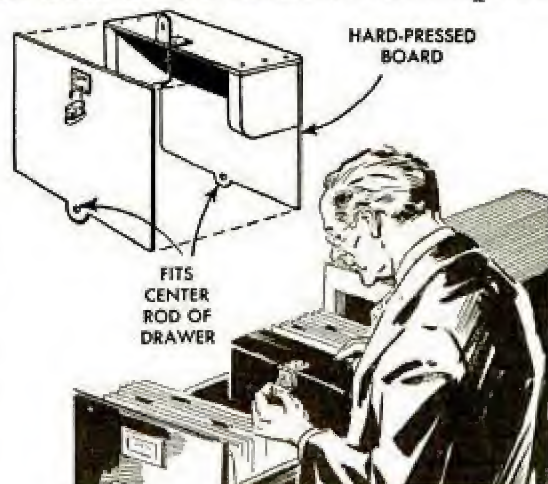
At one large plant where many heavy steel drums were handled with a hoist, use was made of a clamp as shown above, which gripped the drums securely without damaging them and saved considerable time over the usual method of tying slings around them. Working like a pair of ice tongs, the clamp instantly grips or releases a drum, and the heavier the load the tighter the grip of the clamp. When handling drums with smooth sides without reinforcing ribs, where there might be a possibility of the clamp jaws slipping, a safety feature is provided by two lock screws, which can be turned tightly against the clamp arms to make the jaws grip the



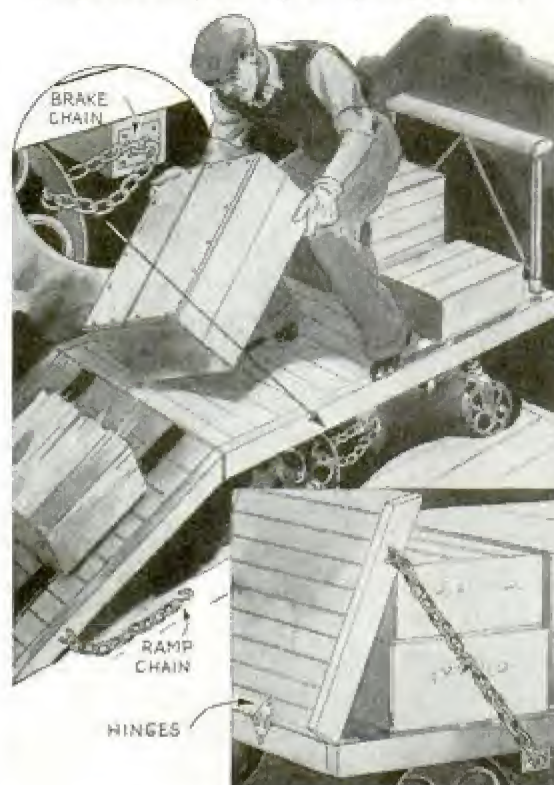
drum firmly. Construction is simple, only a few scrap pieces of pipe and flat iron being needed to assemble the clamp as shown.
—John B. Cleaveland, Gladstone, N. J.

Handy Lockbox in File Drawer Stores Confidential Papers

Personal letters and other confidential papers can be kept in a regular office file cabinet without utilizing an entire drawer if this simple lockbox is used. Made by using a couple of file dividers cut from hard-pressed board and fitted with a narrow top of the same material plus some wood as indicated, the box is locked with a hinge hasp and a small padlock. Use small screws to attach the hard-pressed board and solid-wood parts, and use small stove bolts to fasten the hinge hasp to the thin material. The box can be made any size desired by making the width of the top to suit. Note that each divider has a tab at the lower edge to fit the center rod of the drawer.



Wood Ramp on Platform Truck To Load Heavy Objects Easily



Hinged to the rear end of a platform truck of the type shown, a strong wooden ramp makes it much easier to load or unload heavy objects, as they can be pushed onto the truck instead of being lifted. A chain fastened to the platform holds the ramp in a vertical position when not in use, and is fastened through one of the wheels while loading the truck to keep it from being pushed forward.

Outside Fuel Tank for Heater In Small Brooder House



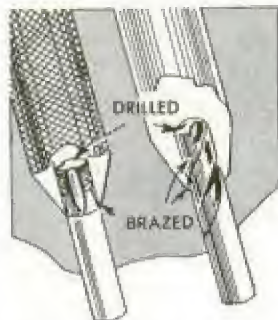
Mounted on a wall shelf outside your brooder house, a large fuel tank like the one shown will be easy to get at, will make it unnecessary to refuel the heater so often and will help reduce the fire hazard of having the tank close to the heater inside the building. The tank is a large covered can, such as a 5 or 10-gal. kerosene can, which is connected to the heater by means of a length of small pipe

or tubing. To keep water or sediment from reaching the heater, a sediment bulb from an old car is installed in the line directly under the tank as indicated. If the tank is mounted as low on the wall as a good gravity feed to the heater will permit, filling of the tank will be simplified.

—A. M. Wettach, Mt. Pleasant, Iowa.

Pin Punches From Broken Drills

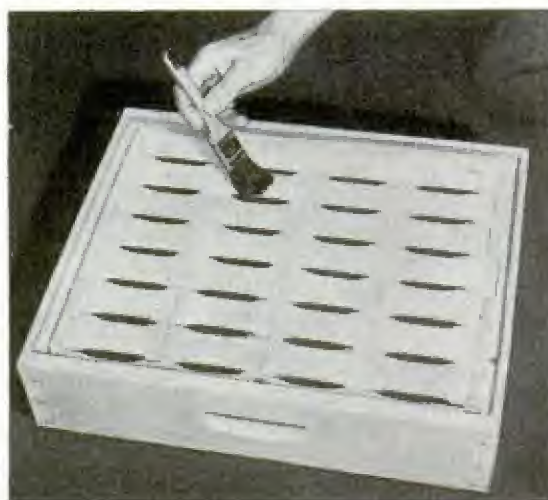
Pieces of broken taps and twist drills can be used to good advantage in making pin punches of various sizes. Handles for the punches can be made from scrap pieces of metal, or you can use the upper ends of broken punches and chisels of the regular type. The ends of the handles are drilled, after which the broken pieces to form the punches are inserted and brazed in place, flowing the molten metal down the drill or tap flutes to anchor them firmly in place. The punches are finished by shaping the ends as desired.



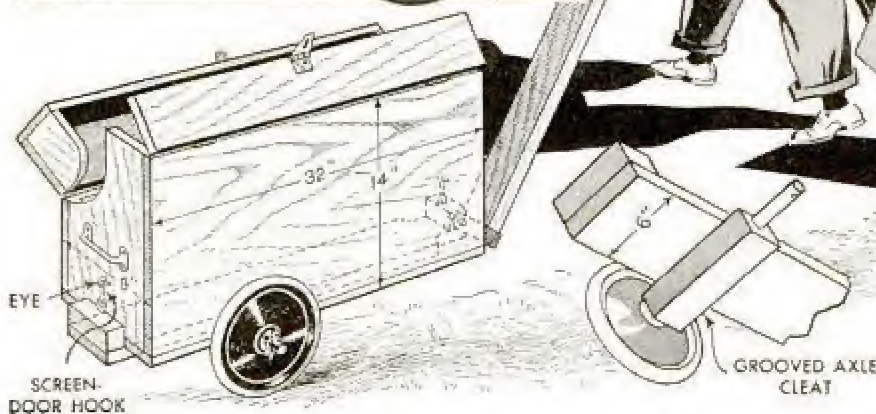
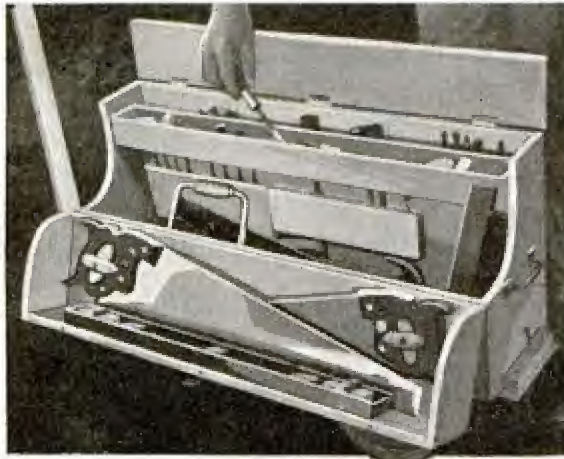
—S. O. Stanfield, Santa Ana, Calif.

Honey Section of Beehive Super Kept Clean With Paraffin

Beekeepers who wish to avoid the stained appearance of the honey sections in their beehive supers can reduce staining to a minimum by coating the upper surfaces of the sections with paraffin. This is brushed on hot before the supers are placed in the hive. When the honey is ready to harvest the wax is scraped off, leaving the section tops clean and white.



This Cart Tool Box Saves Labor on Large Jobs

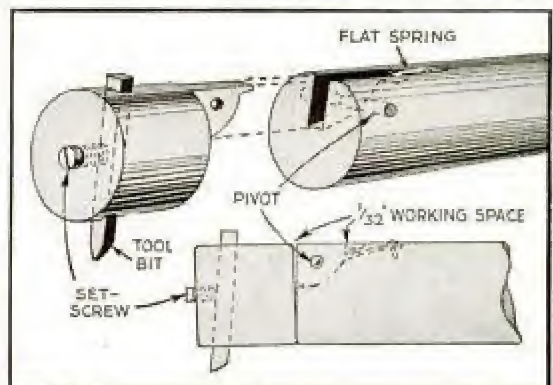


Carpenters and others who work on large construction jobs where tool boxes must be moved about the job frequently, will find this portable box a labor saver as it can be wheeled most places, and can be removed from the cart whenever necessary. Made of hardwood, the box is small enough to be transported in a car, and is designed so that each tool is readily accessible. A small-parts tray near the top of the box is $2\frac{3}{4}$ in. wide, 2 in. deep, and has a $1\frac{1}{8}$ -in. clearance behind it for chis-

els, drills, etc., which slip into wooden holders secured to the side of the box. The edge of the hinged top is fitted with three dowels, which engage holes in the edge of the drop side to make the latter secure when closed. The cart on which the box is moved is very simple, consisting of a 6-in. board to which the wheels and axle of a child's wagon are attached by means of a grooved cleat. A tongue pivoted to the forward end of the cart folds back over it for easy hauling in a car.

Hinged Holder Extends Life of Metal Shaper Tool Bits

Used in a shaper or planer, this hinged cutting-tool holder will be handy on many jobs. Its advantage over the regular type of holder is that the tool bit can lift slightly on the back stroke so that the cutting edge is not chipped or dulled. Notice that a flat spring is used in the slot where the parts pivot. This puts a slight pressure on the hinged part of the holder so that the cutting tool will bite into the work at the start of the forward stroke. Note that a working space of only $\frac{1}{32}$ in. is allowed between the hinged parts, permitting a slight movement of the cutting tool on the back stroke.



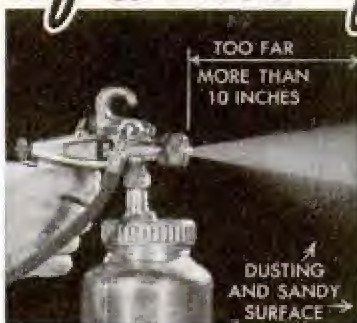


CHECK VISCOSITY



STRAIN MATERIAL

"Manual of arms" for SPRAY



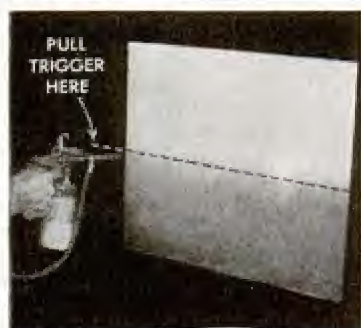
GET THE RANGE!

Holding the gun too close causes an uneven coat, air ripples and possible runs. If the gun is held too far from the work results are dry, sandy spray and excessive dusting. With average home shop equipment, a distance of 7 or 8 in. from the gun to work gives good results



ANGLE OF FIRE

Gun should be held "square-on" when spraying vertical panels. Pointing down, as shown at extreme left, deposits heavy coat along upper edge of spray pattern. At left, keep same distance from work throughout stroke—arcing deposits a heavy coat at the center of the stroke



CORRECT TRIGGERING

Pull the trigger before your gun stroke hits the work; do not release trigger until gun stroke has passed work. Practice triggering to hold overspray at ends to a minimum. Banding panel ends previous to horizontal stroking is good practice and reduces overspray



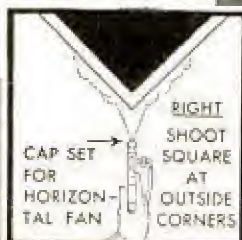
HIT THE FRONT LINE!

When spraying horizontal surfaces, start at the near edge. Spray dust then is projected forward to land on uncoated work where it is dissolved by full spray stroke. Starting at far edge is wrong as it shoots spray dust onto the finished surface coat causing a rough finish



CHECK POSITION OF FLUID TUBE AND MAKE GUN ADJUSTMENTS

GUNNERS

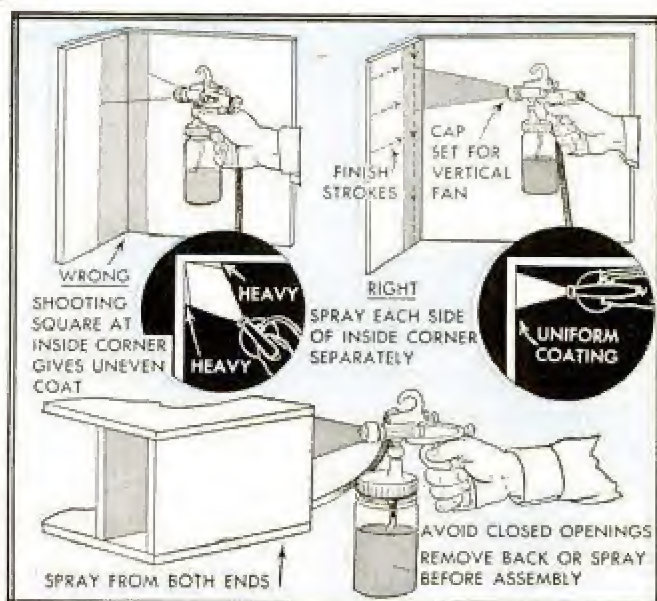


CLEAN UP OUTPOSTS FIRST

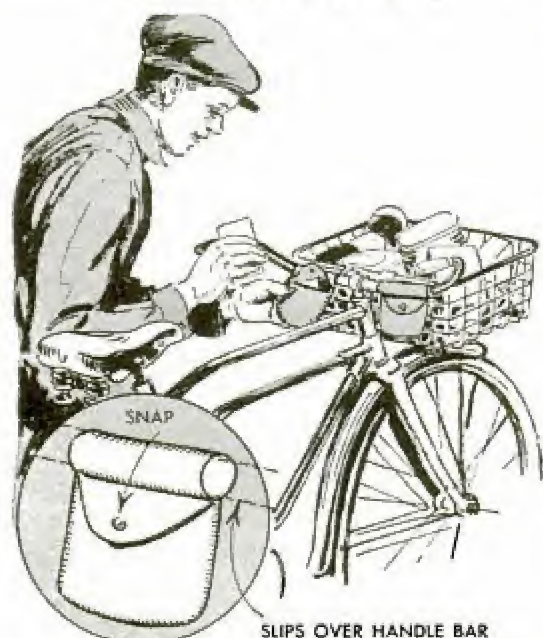
If you shoot the edges and other out-of-the-way places last, you will have a lot of spray dust falling on surfaces already coated. The right way is to shoot edges and similar surfaces first, as spray dust falling on uncoated main areas is dissolved by later full spray coat. Turnings should be sprayed with an up-and-down stroke, with air cap of gun set for vertical fan (horn holes horizontal). Make use of a simple turntable—walking around the work or shifting it by hand is poor practice. Always spray full wet coats just short of running and work under a good light so that you can actually see the finish as it goes on.

GUNNING CORNERS

Shoot square-on at outside corners. This deposits a heavy coat at the corner edge where it is needed. The air cap of gun should be set for horizontal fan. Finish the job with horizontal strokes. Don't shoot square-on at inside corners. This deposits a heavy coat at either side of corner. The right way is to shoot each corner in turn, as shown at extreme right, with air cap set for vertical fan. Finish the surface with horizontal strokes, triggering each stroke to minimize overspray on coated surface. Avoid closed or box openings. It is almost impossible to prevent dusting when you shoot right into them. On many jobs you can remove back panel and spray from both ends of opening



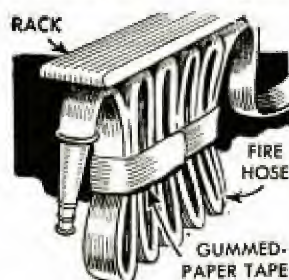
Canvas Bags Slip on Handlebars Of Delivery Bicycle



SLIPS OVER HANDLE BAR

Cut and assembled from canvas, oilcloth or imitation leather, these handlebar bags provide ideal containers for bills, tickets, etc., where delivery boys must be on the job in all kinds of weather. The bags are first cut and sewed so that they will slip over the handlebars easily after which a snap or button is attached to each flap.

Tape Around Racked Fire Hose Prevents Replacing It Wrong



In public buildings where a fire hose on each floor is kept in a rack in such a manner that it can be removed quickly if needed, the hose is sometimes accidentally knocked off the rack and

often is replaced wrongly by an inexperienced person. To prevent this in one building, the racked hose was wrapped with gummed paper tape as shown.

Loosening a Stuck Cylinder Head

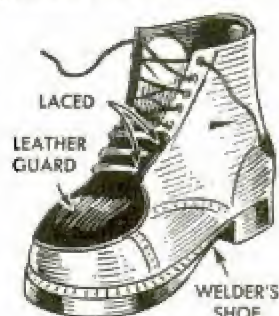
The next time you have an aluminum cylinder head to remove and it has corroded around the studs so badly that it cannot be loosened, try the following: Drill about four $\frac{1}{8}$ -in. holes nearly through the head around and as close as possible to each corroded stud. Then, with an eye dropper,

fill the holes with concentrated ammonia. Also, put a few drops around the studs that do not seem to be corroded. Let this stand for about one half hour, after which the head can be lifted with little trouble.

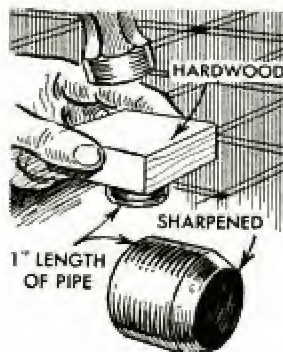
—L. H. McFarland, Mission Beach, Calif.

Welder's Shoes Will Last Longer If Shielded Against Burning

Welders can make their shoes last much longer if a shield is provided to protect the upper parts from hot sparks that fall on them. Guards are provided easily by cutting pieces of flexible leather to the shape indicated. The guards are held in place by the laces, which pass through holes punched on each side of them.



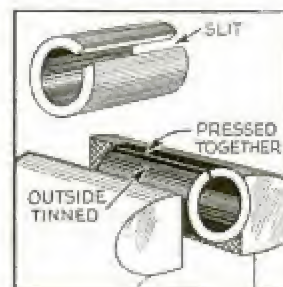
Neat Holes Punched in Linoleum With Short Length of Pipe



To save time cutting neat round holes in linoleum that has been cemented down, one plumber uses a cutter, which he made by beveling the end of a short length of pipe to form a sharp edge. He carries several of these, each cutter being made

from pipe one size larger than the pipe he ordinarily installs. In use, he locates the required hole centers on the floor, places a small block of hardwood on the cutter and strikes it with a hammer.

Worn Bushings in Starting Motor Repaired by Tinning Them

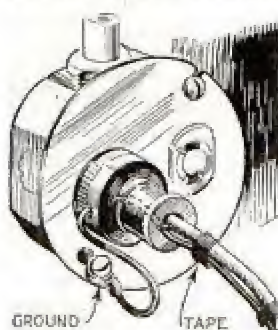


Trouble with car starting motors often is caused by the bushings wearing and allowing the armature to come too close to the pole pieces. While the best method of

repairing such a starter is to replace the bushings with new ones, an emergency repair can be made by coating the outside surfaces of the bushings with solder. First, carefully remove the bushings and slit them along one side with a hack saw. Then, apply a thin coating of solder to the outside surface of each one. This will build up the outside diameter so that the bushings will be centered in the starter casing when replaced. The work must be done very carefully, and the bushings can be reamed to fit the armature shaft if necessary.

Portable Electrical Machines Grounded Easily

In our shop we had a number of portable electrical machines, such as electric drills,



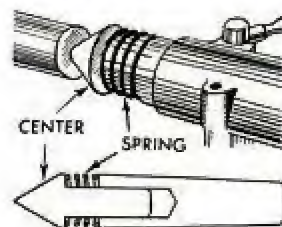
hammers, heaters, etc., that had to be grounded, and since three-wire conductors were not only expensive but almost impossible to get, I did the job with single-wire conductors. These were connected to the machines, run

along the cords into the plugs and then out the side of the plugs as shown, and connected to the conduit boxes, using tape to attach the wire to the cord. On rare occasions when the plugs had to be pulled from the boxes it took but a minute to disconnect the ground wires.

—R. Boettinger, Englewood, N. J.

Spring-Loaded Tailstock Center Regulates Pressure on Work

Finding it difficult to hold lathe centers snugly against the work without adjusting them frequently, I made a tailstock center like the one shown in the lower detail. It consists of two parts,



one being tapered to fit the tailstock shaft and drilled at the outer end to

take the other part, which acts as the center. A coil spring between the two parts maintains a constant pressure against the center to keep it firmly in the center hole of the work. Both parts are made of tool steel and are hardened and tempered.

—Matt Laush, Pittsburgh, Pa.

Metal Basin Makes a Safe Skid For Rolls of Linoleum



To reduce the labor of moving rolls of linoleum across the floor of a stockroom, and to protect the ends against damage, one merchant used several metal basins. One end of a heavy roll of linoleum may be placed in a basin, which then serves as a skid or glider by which the linoleum may be moved safely and quickly.

Air Compressor Mounted on Axle Inflates Tractor Tires

A small air compressor obtained from an auto junk shop was used by one farmer to inflate his tractor tires. The compressor was mounted on the axle and aligned with a pulley on the power takeoff. In this position, the compressor could be belted up in a second and yet was out of the way when not in use.

—A. M. Wettach, Mt. Pleasant, Ia.



The Mechanics of MACHINE FILING

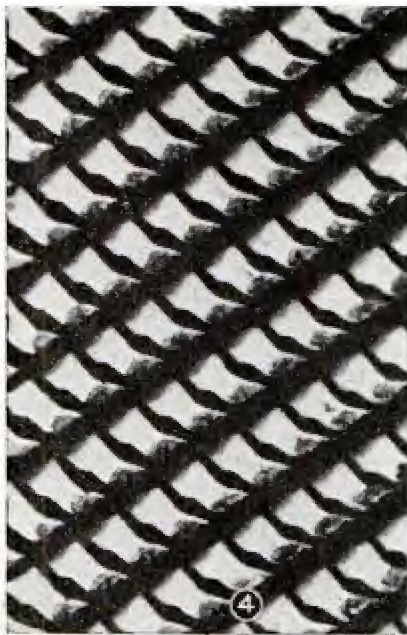


developed for the purpose. They are either chisel-cut or milled, although some of them are produced by etching and a few special ones are still being hand cut. Following a series of processing steps, files are heat-treated to obtain the required degree of hardness. Band files consist of a number of separate file segments connected together as shown in Fig. 7, and mounted on a band of spring steel of considerable strength and flexibility, as shown in Fig. 6. The segments are hardened in groups for the purpose of obtaining uniformity in the degree of hardness, which makes it possible for every segment of a file band to perform an equal share of the work. As a final step, the segments are sand-blasted to give the teeth extra sharp cutting edges.

Obviously, any one file band is not adapted to do all kinds of work on different metals, and therefore a number of different styles varying in cut, shape and width are needed in any large plant where considerable filing is done, although small plants can get along with a limited number. It should be remembered that file bands are precision cutting tools and should be protected against damage by being hung inside a cabinet to avoid damaging the teeth. A file selection chart such as is shown in Fig. 8, should be kept at hand near the file cabinet so that the correct file

By H. J. Chamberland

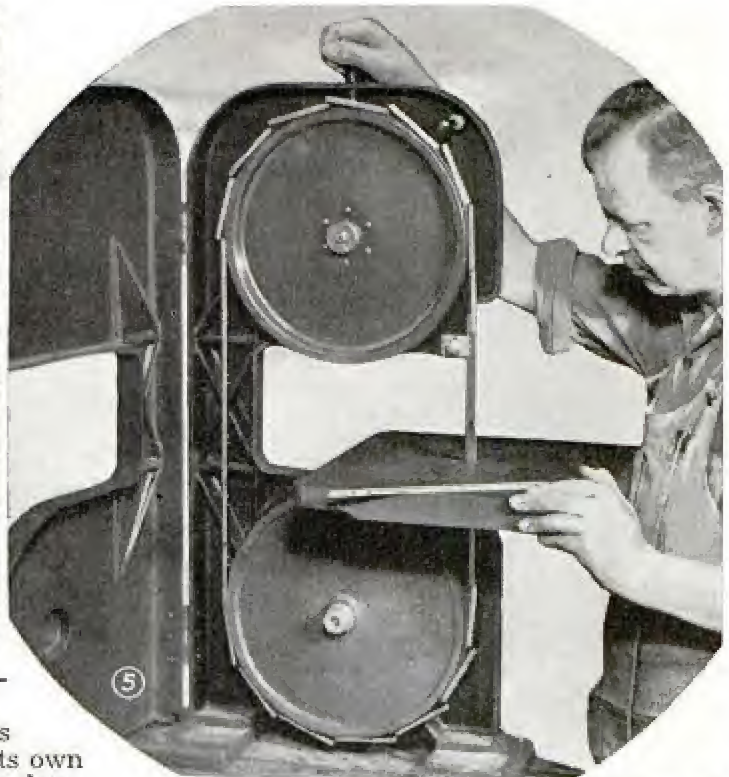
FOR RAPID and accurate filing of metal within close tolerances, modern machine shops make use of both band and jig filers. Band-filing as illustrated in Figs. 1 and 2, is the faster of the two as the file band moves downward against the work continuously. In jig-filing, which is shown in Fig. 3, the file moves up and down, removing metal only on the downward stroke. All files, whether they are hand, band or jig types, are made of special steels



can be selected for any particular job.

There are three different cuts of band files, each one having its own specific purpose. First, there are bastard-cut files, a photomicrograph of which is shown in Fig. 4. These files have teeth of medium depth and are used most widely because they are well adapted for general requirements on metals and plastics. Second, there are mill-cut files (not milled teeth), which have teeth of less depth than bastard files and produce a precision smooth finish. They are used when the objective is quality rather than quantity. The third type of band files, unlike the other two, are vixen-cut; these have deep knife-like teeth milled across the face. This particular cut is most efficient for filing aluminum, brass, copper, zinc and other ductile metals that have a tendency to clog the teeth of other files. Fig. 9 shows several band-file segments of all three cuts.

In selecting a file for any job, the first factor to be taken into consideration is the cut of the file and the second is its width. The wider the file band is, the more material it will remove. The best width depends on the outline of the work. File bands come in $\frac{1}{4}$, $\frac{3}{8}$ and $\frac{1}{2}$ -in. widths. The third factor in file selection, and the most important one, is the choice of "teeth per inch." Band-file segments are available in varying number of teeth, namely 12, 14, 16, 20, 26 and 34 per inch. These variations determine the effectiveness of a file on different materials. Coarse files remove metal more rapidly



than fine ones, and do not become loaded with chips so readily. For faster, cleaner and smoother cutting action, most band files are double-cut to form additional "peaks" or teeth in the files. To further fill requirements of efficient cutting, file segments are made in flat, oval and half-round shapes.

File teeth work in the same manner as saw teeth; a small chip curls up before each tooth and is dropped when the tooth clears



⑧

SELECTING CORRECT BAND FILE FOR JOB

filing machine. Note how the segments react on the steel band as they travel around the wheels and have the appearance of a single file when passing through the file guide. The band on which the segments are mounted does not stretch and for this reason the tension remains fixed once it is adjusted correctly. Although file segments do not vary in thickness and width more than .0005 in., and are fitted carefully on the band, the assembly must track true or a "bumpy" cutting action will result. Fig. 12 shows how a file band is checked for proper tracking by using a piece of chalk in the same way that concentricity of work on a lathe is tested. The file band must be supported rigidly on both sides and rear by a guide.

For filing square or rectangular shapes as in Fig. 13, flat files are used, but for curved surfaces, oval files are used as



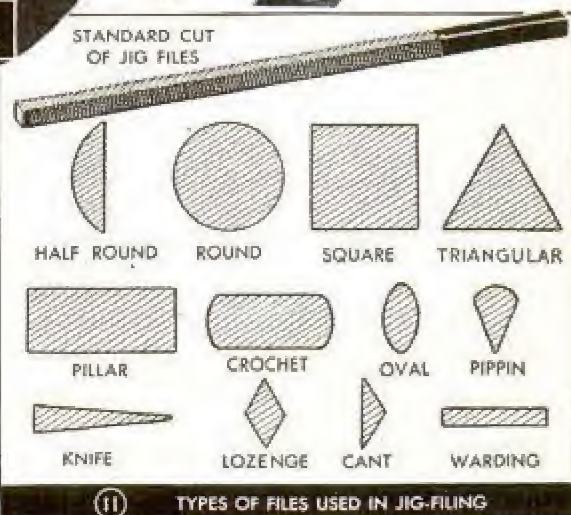
⑨

VARIOUS CUTS IN BAND FILES

A, B & D — BASTARD
C — VIXEN
E & F — MILL

FILE DAMAGED BY OVERHEATING

STANDARD CUT OF JIG FILES



⑪

TYPES OF FILES USED IN JIG-FILING

the work. Excessive heat that results from the use of an inefficient file on any job may cause damage to the teeth as shown in Fig. 10, and also to the work itself. Clean cutting of files is essential to avoid heat. Some materials that can be filed easily with a coarse-cut file, become nearly impregnable to the heated and chip-crowded teeth of a fine cut or finish file. A $\frac{1}{4}$ -in., 24-tooth file band will remove cast iron at the rate of approximately 9 oz. per hr., whereas a $\frac{1}{2}$ -in., 16-tooth file will remove this metal at the rate of about 38 oz. per hour.

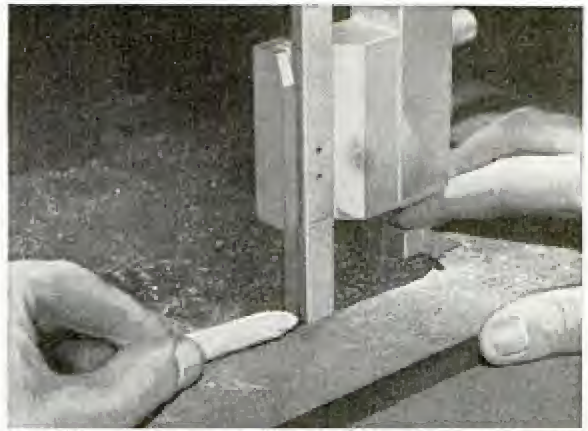
Fig. 5 shows the interior of a band-

in Fig. 14. In this case a $\frac{1}{4}$ or a $\frac{3}{8}$ -in. flat file is substituted for the oval file in order to finish the parallel sides. Excessive pressure or feed applied to the work is not quite so detrimental in band-filing as it is in band-sawing. For most work, the pressure should be medium, with the part held evenly against the band. However, a file band can stand considerable feed if not abused as is shown in Fig. 16, where a file is being tested for life hours. Note the deep cuts that can be made.

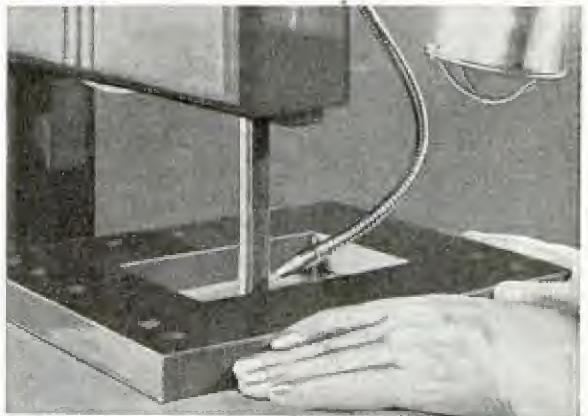
Band-filing speeds (velocity of the band in feet per minute), generally are much slower than they are for band-sawing. For example, when band-sawing aluminum, the saw velocity should be about 1,400 feet per minute (f.p.m.) but in band-filing it should not exceed 165 f.p.m. Recommended velocities for band-filing on other materials are as follows:

Cast iron.....	115 f.p.m.
Cold-rolled steel.....	85 "
Tool steel	60 "
High-chrome steels.....	50 "
Brass	175 "
Most plastics	125 "

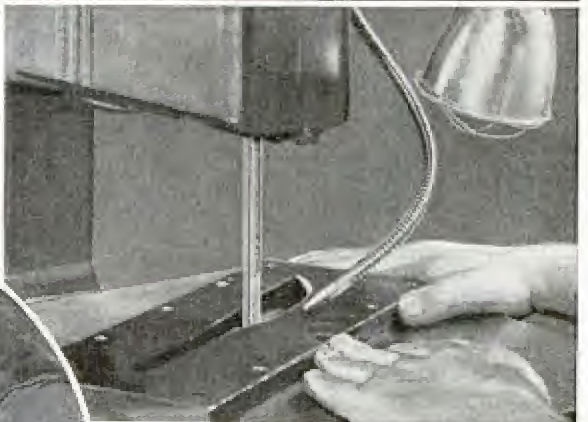
The combined effects of correct file selection, feed and velocity influence the degree of accuracy possible in band-filing. The three openings in the steel block shown in Fig. 17 are being filed to within .001 in. of exact measurements. Incidentally the operations that are shown in Figs. 16 and 17 were performed in a specialized band-sawing machine having a specially fitted file guide. The operations that are shown in Figs. 13 and 14 were done in a regular band-filing machine. Fig. 18 shows a $\frac{1}{4}$ -in. half-round file be-



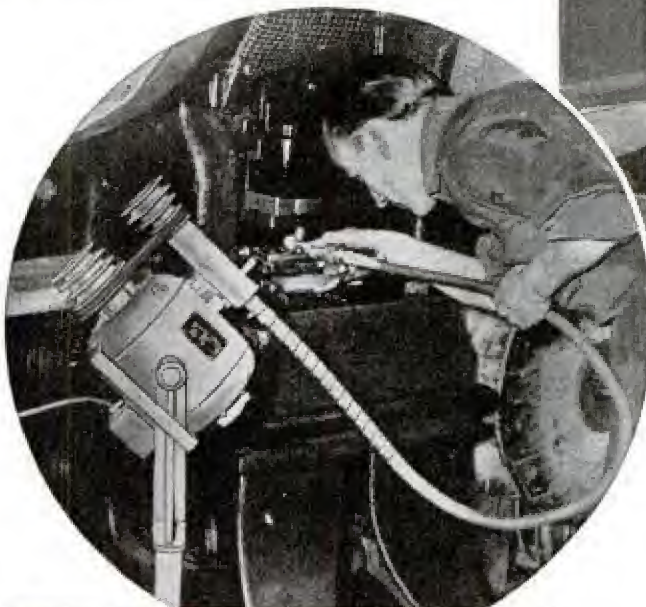
(12) HOW FILE BAND IS CHECKED FOR TRACKING



(13) FLAT FILES FOR STRAIGHT SURFACES

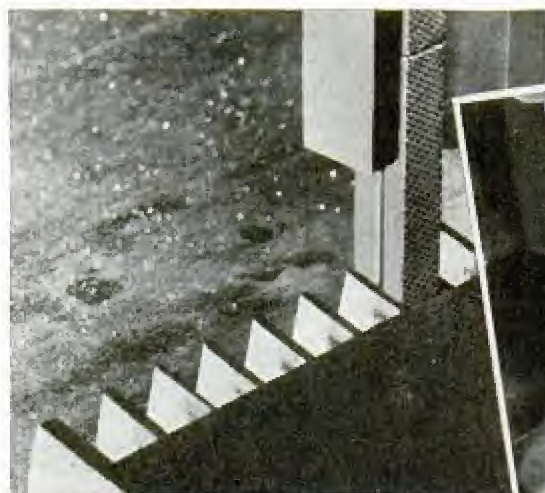


(14) OVAL FILES ON CURVED SURFACES

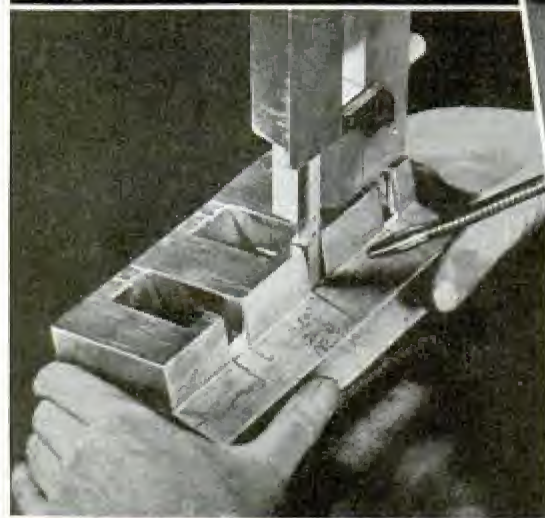


(15) ROTARY FILE USED TO REPAIR DIE

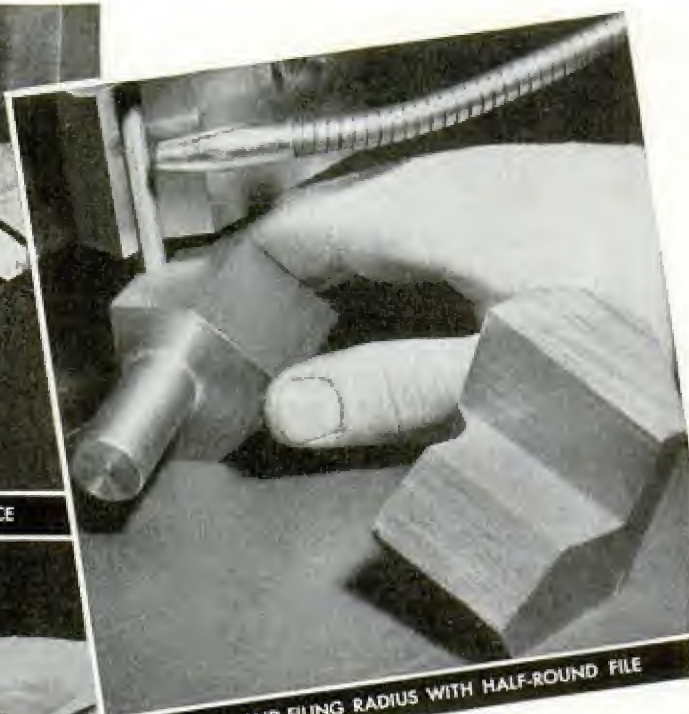
ing used to finish a radius of a curvature. In such cases, the size of the radius determines whether a half-round or oval file should be used. For some jobs small rotary files are convenient. They are made in numerous shapes and are driven by a flexible shaft as shown in Fig. 15 and are of great advantage for repair work, as the filing unit can be taken directly to the job. Also, they do not require any time to set them up for a job as is



(16) BAND FILE TESTED FOR PERFORMANCE



(17) FILING SAWED OPENINGS TO .001 IN.



(18) BAND-FILING RADIUS WITH HALF-ROUND FILE

twelve shapes are considered as standards, there are many other shapes available which are made to order for individual needs. The teeth of jig files are cut the reverse of hand files as they remove metal on the downward stroke. For maximum file life, first select the proper file for each job; second, always machine work before filing so that a minimum amount of metal has to be filed; third, keep a file brush at hand to remove chips from the file at 10-min. intervals.

Most types of jig filers have five speeds ranging from 150 to 400 strokes per min. The correct speed depends on the nature of the material to be worked on as is the case with other files. Brass, copper, zinc and aluminum, which require coarse files, can be worked at 300 to 400 strokes per min. Cast iron is best filed at 250, mild steel at 200 and tool steel at 150 strokes per min. The special advantage of a jig filer lies in the fact that it can be used for precision work on small parts such as gauges, small forming tools and light dies.

the case when band or jig filers are used.

The jig-filing machine, Fig. 3, is regarded as a small die-making machine. While the band filer and jig filer perform identical work, jig-filing requires more experience and attention to obtain band-filing accuracy. Jig files are made in but one design of cut but are available in coarse, medium and fine spacing of teeth. There are twelve various shapes of jig files as shown in Fig. 11, and five sizes to suit most angles and contours generally encountered. While all

How You Can Reduce the Cost of Cleaning Paintbrushes

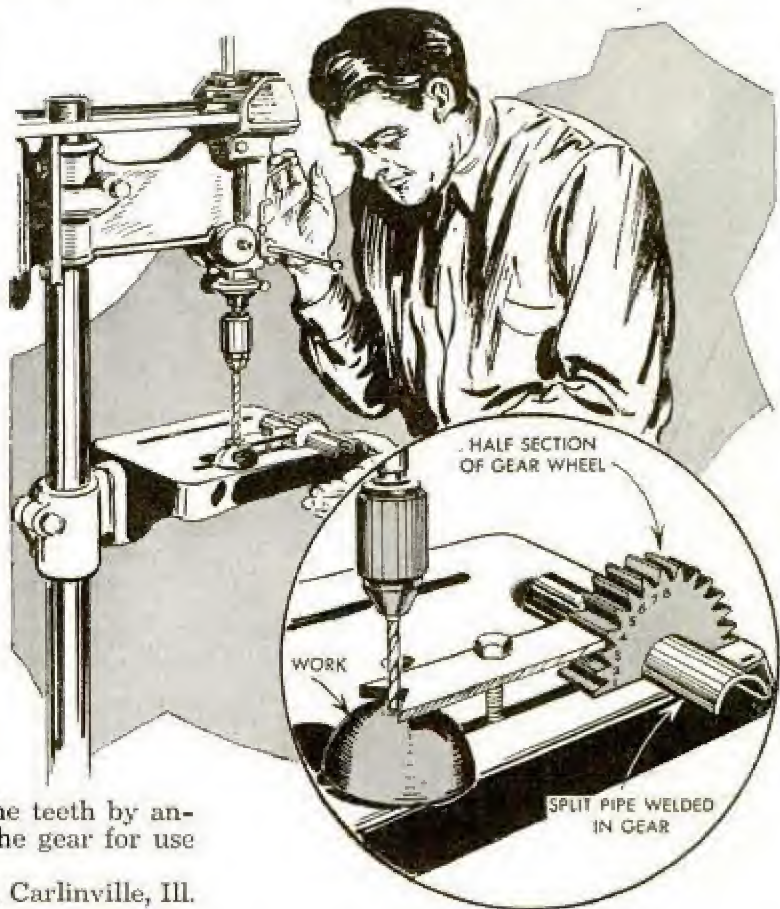
Painters who use large quantities of liquids in cleaning their paintbrushes can effect a saving in these materials by the following method: Clean four empty paint cans that have tight-fitting lids and fill one with turpentine, one with benzine, one with lacquer thinner and one with alcohol or shellac solvent. Use these solvents for rinsing your brushes and do not throw out

the liquids. Paint and other material will settle to the bottom of the cans, after which the liquid should be poured off carefully into another container and the cans wiped clean. In this way, the solvents can be used for many brush cleanings. Use benzine for paintbrushes, turpentine for enamel brushes, lacquer thinner for lacquer brushes and alcohol for shellac brushes.

Stepped Hold-Down for Work on Drill Press

A stepped hold-down that can be adjusted quickly for holding work securely on a drill-press table is easy to make by using a half section of an old gear wheel. The gear section is stabilized with a short length of split pipe welded to it as shown. The number of steps available will be one fourth of the number of teeth in the whole gear. For example, a 32-tooth gear will provide a block having eight steps. When a wide gear is used, it will be unnecessary to stabilize it. If you have access to an abrasive cutting wheel, it will be easy to cut even very hard steel gears or casehardened ones. However, if no wheel is available and the gear is too hard to be cut with a hack saw, it may be annealed first and then cut to suit. Softening of the teeth by annealing does not damage the gear for use as a step hold-down.

—W. C. Wilhite, Carlinville, Ill.



Numbering Rugs in Stack Helps Customer Make Choice

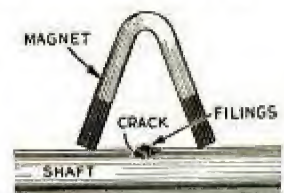
One furniture dealer discovered that by numbering rugs stacked in his store his customers were better able to make selections and time was saved for the salesmen. The numbers are painted on pieces of card-

board, which are clipped to the edges of the rugs with clothespins. Thus, as the salesman turns over the rugs, the customers can note by number the rugs in which they are interested. In this way, the salesman can turn back quickly to any particular rug the customer wishes to see.

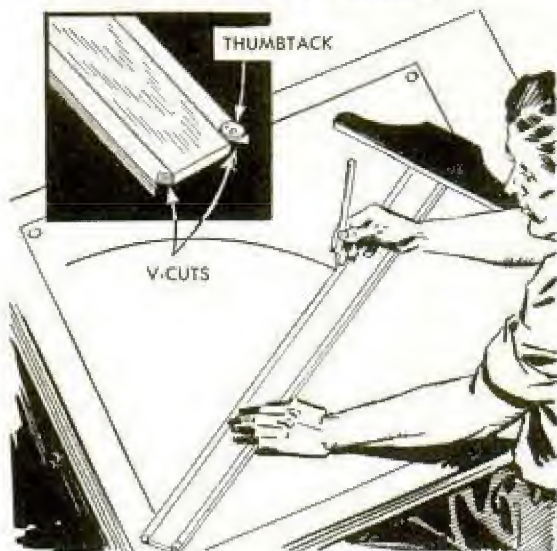


Magnet Tests Cracked Shafts

To determine if a crack in a cylinder head, axle shaft or drive shaft has penetrated far enough to cause a break of the part, use a V-shaped magnet as shown. Set this on the shaft so that the crack is directly between the two magnetic poles. Then if steel or iron filings are sprinkled sparingly on the crack, they will stand on end if the crack has penetrated the metal deep enough to cause a break.



Neat Arcs Drawn With T-Square Pivoted on Thumbtack



When working on a plan which included several large arcs, one draftsman found that his T-square could be used to draw these accurately. This was done by cutting a couple of V-notches in the end of the T-square beam as indicated so that it could be pivoted against a thumbtack pressed into the drawing board at one corner. The radius of the arc was then marked on the beam to locate a pencil or pen for drawing the desired lines. Where such an arrangement is used frequently, dimensions can be lettered on the bottom of the T-square for quick adjustment of the pencil.

Leaks in Car Cooling System Located With Air Pressure

As leaks in a cooling system do not always show up when the car is at rest, one mechanic applies very low air pressure to the radiator to help locate them. The air



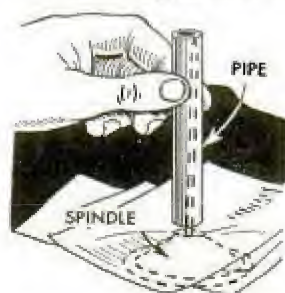
hose is placed in the filler hole, the overflow pipe is plugged and a cloth wad is pushed down around the hose to prevent excessive leakage. As care must be taken to prevent damaging the radiator, the cloth is pressed down just tight enough to hold a pressure of a few pounds.

Gaskets From Screen Wire

In case regular gaskets are not available, a good substitute can be made from screen wire and gasket or furnace cement. The screen is cut to the gasket shape, after which cement is forced into the meshes. When the cement is partially set, the gasket is bolted into place and time allowed for the cement to harden. The gasket will then provide a permanent seal.



Length of Pipe Serves as Guard For Spindle Paper Holder

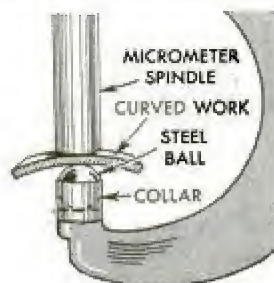


If you have a paper spindle or spike on your desk to hold bills, receipts and other papers, it's a good idea to provide a shield or guard for the sharpened end to avoid accidents. This can be done

by slipping a length of pipe over the spindle, which also aids in thrusting several sheets of paper on the holder at one time.

Steel Ball on Micrometer Anvil To Measure Curved Surfaces

One mechanic who often had to use a micrometer on curved surfaces attached a steel ball to the anvil of the micrometer so that he could do the job accurately. The ball is held in place by a collar made from a short piece of tubing. When using this method, allowance for the thickness of the ball must be made.





Radio

Helpful Antenna Hints

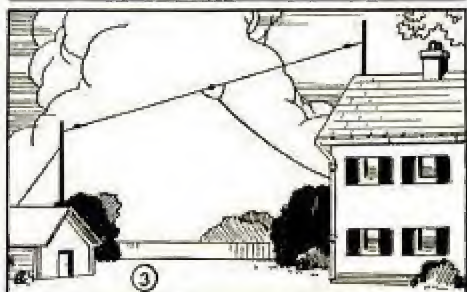
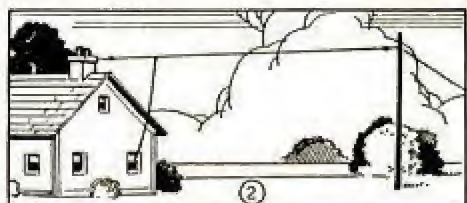
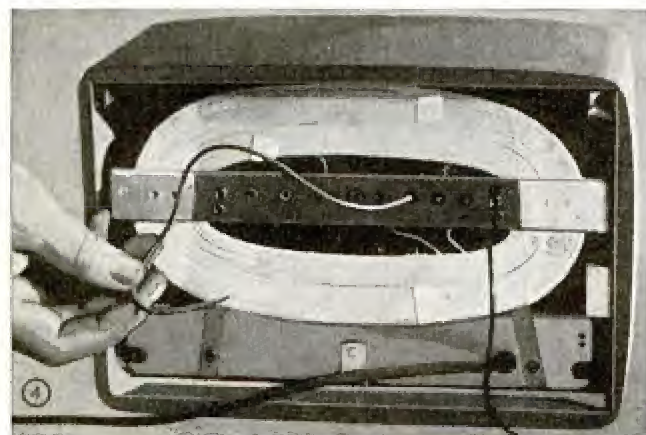
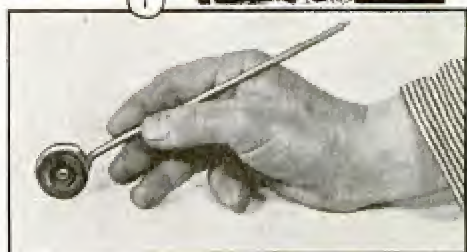
NEGLECTED antenna installations handicap any type of radio receiver that is designed to operate on an outdoor "sky wire." Unnecessary service calls can be avoided in many cases of intermittent program breaks, and fading signals, by simple first aid methods.

An inspection of the antenna may reveal that the wires are loose and swinging in the wind. They may be coming in contact with tree branches or touching the building. The lead-in wire is a common source of trouble. In many hurriedly made installations this insulated wire will be run directly across drain pipes and metal gutters. Constant rubbing will soon cause shorts to ground as indicated in sketch Fig. 1. A simple remedy is to run it through a common 7 in. porcelain eye stand-off insulator of the type shown in the photo.

If you have an unsatisfactory antenna system, the inverted L type shown in Fig. 2 is recommended if the building and vicinity are electrically quiet. The simple doublet antenna shown in Fig. 3 reduces noise pickup by the down lead where it must pass through man-made static areas.

Soot-covered insulators should be cleaned with a fairly strong solution of sal soda followed by clear water. Look for loose or corroded connections on the window strip and at the lightning arrester.

Many small receivers employ a loop antenna as in Fig. 4. These sets have external antenna and ground leads that should be used for distant stations; the black wire goes to ground.



"POP CORN CAN"



HERE is a simple a.c.-d.c. oscillator constructed from non-critical parts to meet a wartime need. It provides a practical means for obtaining modulated or unmodulated signals for classroom work and emergency home set servicing. These signals may be employed for lining up IF transformers in superheterodyne receivers, for "ganging" condensers on supers and TRF sets and provides useable harmonics down to 14 megacycles for calibrating receivers from the harmonics of broadcasting stations.

This unit will hold its calibration quite accurately for rough and ready work on the test bench. Housed in a tin pop corn can, it is thor-

oughly shielded; any similar can about 6¼ in. wide and 8 in. high may be used. The oscillator covers a band of from 550 to 1,500 kilocycles by means of three plug-in coils. All coils overlap sufficiently so that there will be no gaps in the tuning range if any old variable condenser having a total of 20 or more plates is used.

The 7A7LM loctal-type tube is interchangeable with 7A7 and will be found in most dealers' stocks. Students may substitute a 6K7-GT or a 6J7 tube with simple socket changes. A 6C5-GT, or GT/G tube is employed as a rectifier.

The schematic circuit diagram is given in Fig. 1 and the simplified wiring diagram with parts values in Fig. 3. Photos A, B and C show various views of the completed unit.

Provide room for the variable condenser so that the rotor plates

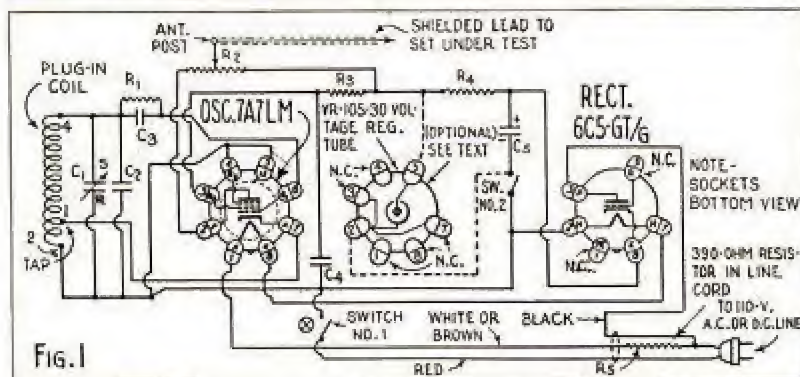


FIG. 1

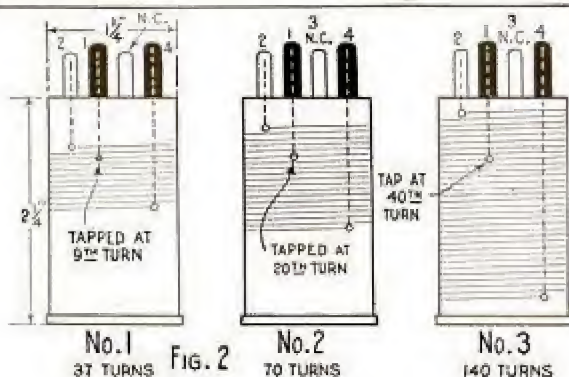


FIG. 2

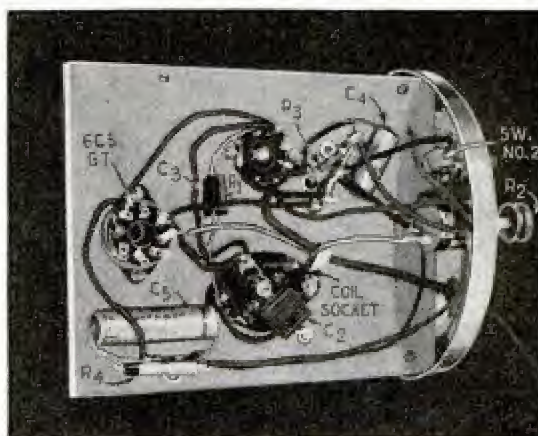


SIGNAL GENERATOR

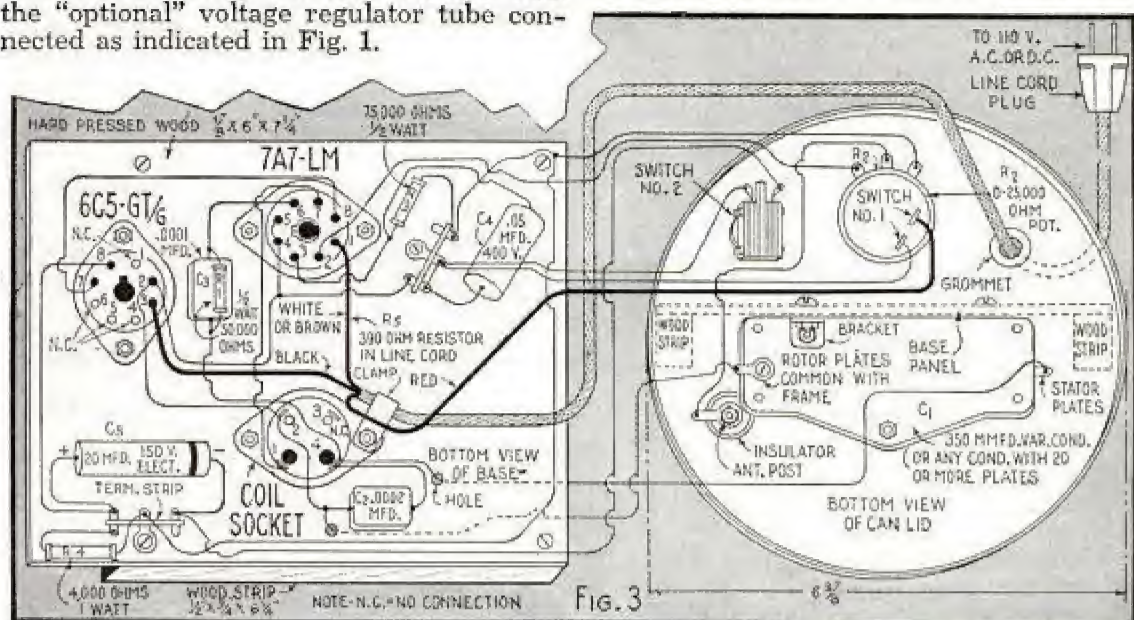
lines up any receiver

will clear the can when fully open. Any salvaged wire or common "bell wire" may be used for the circuit, and either No. 28, 30 or 32 scrap enamel, silk or cotton-covered wire for the coils, Fig. 2. These are all close-wound on standard 4-prong coil forms. Detailed list R-316 is available if desired. To test the oscillator, plug in coil No. 2, turn on switch No. 1, and tune in a station on your receiver. Rotate (C_1) until you hear a sharp whistle in the set. The oscillator can be calibrated for the broadcast band by tuning in a number of stations of known frequency and then plotting a curve, or chart, of the dial settings; make a chart for each coil. Coil No. 3 tunes from 550 kc. to roughly 400 kc. thus covering the standard 456 kc. I.F. frequency. Ground the shield on the connecting antenna post test lead to the ground post on the receiver under test.

To line up tuning condensers, tune to the "high" end of the band; switch No. 2 throws filter condenser C_5 out of the circuit to give a modulated tone. Adjust condensers for maximum output with this tone signal. With oscillator set for 456 kc., line up I.F. stages by direct grid connections. To calibrate short-wave receivers, the oscillator is tuned to broadcast stations of known frequency and then the harmonics are picked up in the short-wave bands. There will be strong harmonics down to 14 megacycles. Although the circuit is quite stable even under varying line voltages, some students may desire even more stability and can obtain it with the "optional" voltage regulator tube connected as indicated in Fig. 1.



Above, pressed wood base panel mounted on wood strips screwed to underside of can lid



Keeping an Eye on Television's Scoreboard



PROGRESSING from the flickering image of Felix the cat to the clear picture of the good looking nurse, television has marched steadily on to what will be an important postwar industry and a useful public service.

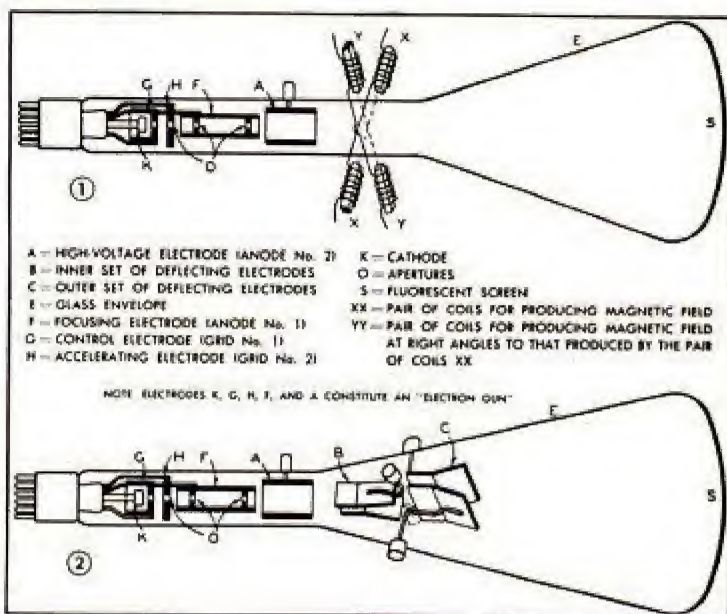
Felix was the product of motor-driven whirling disks at both the transmitter and the receiver. These early scanning disks cut the image up into 60 horizontal lines, or streaks of light. Mechanical scanners were soon replaced by the electronic system of television, then step-by-step the number of lines per picture were increased until a fairly satisfactory image of 343 lines appeared in 1936. Newly designed equipment soon produced finer pictures of 441 lines, and just previous to Pearl Harbor these had been stepped up to the excellent 525 line television pictures that were on the air from the NBC station in New York City. These three unretouched pictures were photographed directly from the television receiver screens. All streaks have now vanished and continued improvements are being made at several of the large laboratories, within the limits of all-out war production.

A large cathode-ray tube

is the heart of a modern television receiver. From its external appearance this tube seems to be a simple device, however there is much more to it than is evident from a casual inspection. The schematic arrangement of the electrodes in a cathode ray television receiving tube are shown in Figs. 1 and 2. The "electron gun" at the small end of the tube produces a beam of electrons and is equipped with an electrical "valve" which varies the intensity of the

beam in accordance with variations in the received radio-television signal. The beam is focused to a spot on the screen at the large end of the tube. Deflecting elements of either the electromagnetic type shown in Fig. 1 or the electrostatic type shown in Fig. 2 deflect the beam both horizontally and vertically in accordance with the synchronizing impulses received along with the picture signal. This rapidly moving electronic beam "paints" a duplicate of the scene being viewed by

the television "camera," in the transmitting station, directly on the fluorescent screen (S) at the end of the tube. The beam-deflecting elements are either placed around the tube as indicated in Fig. 1, or, built into it as in Fig. 2. The sound accompaniment of a television broadcast is handled about like an ordinary radio program. Both sight and sound frequencies will be received simultaneously on your postwar television receiver.





THREADS THAT LIVES MAY HANG ON

The lives of flying crews may hang on the threads of nuts which stay put — hold fast against the chatter of gunfire, the throb of pulsing engines.

We make such a nut. We have made more than three billion of them. And as far as is known, not a single one of these nuts has ever failed in service.

It is the special virtue of Elastic Stop Nuts that they never loosen, slip, shake off or break.

Small wonder they are used on every airplane made in America — as many as 50,000 in a single ship.

Some day these nuts will be available for purposes other than the grim jobs of war.

When they are, automobiles will be tighter and safer and quieter — everything from garden tools or farm tractors to radios and vacuum cleaners will give longer and less troublesome service.

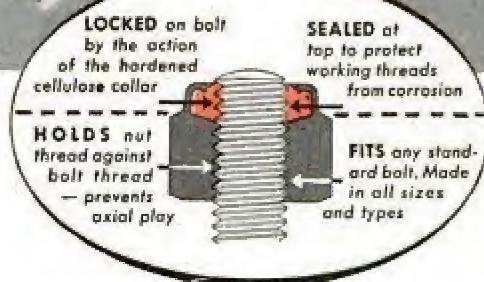
But that's for the future. Today, all these tenacious nuts we can make go for an even more important purpose — which is the simple task of holding tight till the war is won.

ELASTIC STOP NUTS

Lock fast to make things last



ELASTIC STOP NUT CORPORATION OF AMERICA
UNION, NEW JERSEY



THE "Pals" THEY LEFT BEHIND



are Harley-Davidsons

Letters continue to pour in from men in the armed services telling how they miss the Harley-Davidson Motorcycles they left behind. One outstanding feature of ALL these letters is the way every man speaks of the stamina, power, and rugged dependability of his Harley-Davidson "sweetheart." And they look forward to the day when they can again thrill to the ownership of new Harley-Davidsons — motorcycles with greater performance than ever, made possible by the severe tests of wartime action.

HARLEY-DAVIDSON
MOTOR COMPANY

Department PM
Milwaukee, Wis.



Writes today for your
FREE copy of "Enthusiast"
magazine, filled
with motorcycle action
pictures and stories.



HARLEY- DAVIDSON MOTORCYCLES

Uncle Sam Picks an All-Star Team

(Continued from page 55)

pectedly and buzzers rasp. Crazy? Just about as crazy as a fox, according to the achievement records.

One apparatus tests the co-ordination of hands and feet. The subject sits on a low seat, his hand on a joy stick, his feet on a rudder bar. The co-ordination of movements is recorded by red and green lights on a panel before him. Another reaction time test calls for the manipulation of four buttons in response to flashing lights.

Occasionally, an exception to the rule jars the psychologists and they set to work to plug the leak that permitted the misclassification. Perhaps it's a man who easily grasped theory but became all thumbs in practical application, or a smart aleck who deliberately misled his interviewer.

Great advances have been made in the classification of soldiers since the last war. The National Research Council's Committee on Classification of Military Personnel, under the expert guidance of the noted psychologist, Walter V. Bingham, has won wide acclaim.

"We're doing the best job we can in a hurry," says Dr. Bingham. "At the end of October, 1940, there were only 34,405 officers on active duty and 483,218 enlisted men. When one considers the size of our army today he can appreciate the magnitude of this classification job. How the job has been performed will not only have a vital effect on winning the war, but on the lives of the men after it's over."

Uncle Sam's "all stars" won't be quitting when the whistle blows after the ball is pushed over the Tokyo and Unter den Linden line. Skills learned in the army will be set to work building a better nation.

The correct answers to the mechanical aptitude problems on pages 52, 53 and 54 are: No. 1, A; No. 2, B; No. 3, A; No. 4, A; No. 5, B; No. 6, A; No. 7, B; No. 8, A; No. 9, B; No. 10, B; No. 11, A; No. 12, B.

Adventures of Yankee Rangers

(Continued from page 43)

ment. The raiders lead adventurous lives but adventures are much easier to read about than to endure, so the men chosen are selected carefully from the volunteers. Then a special training course is started.

They toughen themselves on an obstacle course, they learn hand-to-hand fighting, judo, the use of the bayonet and small arms. They learn to snipe and they get

(Continued to page 148)



A LOT GOING ON IN THIS PICTURE— AND A LOT GOING ON IN INDUSTRY

It's big, dramatic. You can see it. But you can't see the idea that made it.

You can't photograph ideas. But they win wars. They make jobs. They make prosperity. They make well-being.

They used to come as a revelation once in a while, almost like a miracle to an individual. Now, there are teams that insure them.

Groups that keep ideas flowing. People who know how to dip into the wealth of nature for what they need.

They are scientists. They work together in laboratories.

They are working at the Bell Laboratories. Thousands of them. This is the biggest industrial laboratory in the world. Once its work was all telephone. To help your voice reach any one, anywhere. Easily, quickly, at low cost. Now it's war. Day and night. Seven days a week.

Our fighting men see the results of American research every day.

BELL TELEPHONE SYSTEM



Help the war by making only vital calls to war-busy centers. That's more and more essential every day.



Photo by U. S. Army Signal Corps

WE MUST NOT "let him down" with poor equipment! See those snap buckles? They help to harness him securely to his parachute. They've got to be strong—light—smooth—and without defects!

They're forged from tough alloy-steel. Then files of high quality, and proper cut and shape, are used to remove all fabric-wearing burrs and roughness—to prepare the buckles for plating or polishing.

As in the case of hundreds of other important industrial filing operations, Nicholson makes and has helped to select *The right file for the job.*

Seventy-nine years of experience reflect Nicholson's ability to make the best possible files for every kind of work, material and desired result. Nicholson and Black Diamond are the top-honor brands in this world-famous line of quality files.

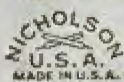
FREE — NEW BOOK, "FILE PHILOSOPHY," for production and purchasing heads, foremen, key mechanics. Tells about the more frequently used of 3000 kinds, cuts and sizes of files Nicholson makes; about files for special purposes; how to use, care for and select the right file—48 interesting pages.

NICHOLSON FILE CO., 22 Acorn St., Providence, R. I., U.S.A.
(Also Canadian Plant, Port Hope, Ont.)

NICHOLSON

FILES

FOR EVERY PURPOSE



MADE IN U.S.A.

plenty of ammunition for practice. They learn the technique of knife throwing, and enough anatomy to be able to finish off an enemy with one knife blow at close quarters. They learn how to aim a gun after dark at sounds, and how to knock down indistinct targets at long range. They learn street fighting, how to operate an enemy vehicle, and how to destroy it.

During their training course they handle and release explosives so that they will be letter perfect in how to use them. They are taught how to advance under fire and do operate under fire while being trained.

They learn how to live off the country, how to spot water holes, how to kill and butcher their own meat, and how to steal food and supplies from the enemy. They carry no money or supplies and it's up to them to steal the food they need. Records are kept of training thefts so that unsuspecting farmers can be recompensed later. In training, the Ranger units go without ordinary comforts. There will be no room on their light trucks to carry anything except the necessary supplies of war. Their whole philosophy is based on the knowledge that casualties among raider units are high and that it's up to each individual to make the enemy pay a dozen or a hundred men for his life.

In turn, our own command posts and supply units are being taught how to avoid surprise by enemy raider groups. For instance, Capt. Overton, ex-leader of "Terry and the Pirates," is now aide-de-camp to Gen. Walton H. Walker, commander of one of the armored units. Under Overton's tutelage, all the officers of the staff have learned the elements of rough and tumble tactics. They have a surprise all prepared for any enemy group that might manage to sneak in on a raid.

Art Detectives

(Continued from page 79)

has to paint them in, but in doing so he is careful to use a sort of paint that can be removed easily and he is likely to handle the repair painting in such a way that it can be easily detected on close examination, so there is no mistake about what part of the painting is the original and what is repair.

"And he is especially careful not to cover up original painting with repainting. His object is to preserve as much of the original as is there to be preserved. Finally he must protect the whole by transparent varnish that can be washed off easily by the use of proper solvents without injury to the painting beneath.

(Continued to page 150)



You may
worry about
missing
the boat

but here is one worry you can avoid

YOU can "miss the boat" these days, if you lose the use of your car. And lose it you may, if irreplaceable engine or chassis parts break down.

Even though you drive your car much less, it needs regular care. Batteries go dead for lack of use, tires need constant checking. Water and sludge in crankcase may rust idle bearings and pistons. Scale and rust can ruin your radiator.

Avoid such worries with Marfak 40-Point Chassis Lubrication Service. Your dealer checks your car, point by point, from fan to differential *against his Marfak chart*. No guesswork here, Marfak means *accurate* protection for every vital part.

That's why your car is *right*, when it's had Marfak Lubrication—*right* for keeping it on the job for you and Uncle Sam. Insist on genuine Marfak Lubrication. At Texaco and other good dealers everywhere.



TUNE IN: FRED ALLEN every Sunday night.
See your local newspaper for time and station.

You're Welcome at **TEXACO DEALERS**

WANT SOME TIPS ON BORING TOOLS?



FREE! WILLIAMS' TOOL DATA SHEETS

● If you operate a lathe, you'll want Data Sheet No. 2. It discusses modern tools for boring and internal threading. Other data sheets in this free series (all punched for 3-ring binder) cover the subjects listed below. Circle the numbers on coupon indicating subjects desired and mail today.

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| 1. Characteristics of Williams' "Superior" Wrenches. | 7. Data on Williams' Turning-Tools. |
| 2. Data on Williams' Boring Tools. | 8. Data on Williams' "Superior" Wrenches. |
| 3. Data on "Vulcan" Chain Pipe Tongs. | 9. Saving Time with Williams' "Supersockets" |
| 4. Data on Williams' "Supersocket" Wrenches. | 10. Data on "Vulcan" Eye Bolts. |
| 5. Data on "Vulcan" Lathe Dogs. | 11. Data on Williams' "C" Clamps. |
| 6. Data on "Vulcan" Chain Pipe Vises. | 12. Use of Williams' Cutting-Off Tool Holders. |
| 13. Use of Williams' Knurling Tool Holders. | |

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Please send Data Sheets circled below:

1 2 3 4 5 6 7 8 9 10 11 12 13

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Address _____

City _____ State _____

WILLIAMS
SUPERIOR DROP-FORGED TOOLS

The art detective also restores vases, bowls, statuettes and similar pieces of art, mostly ceramics, marble and bronzes, which may have been buried for centuries. The ceramics often come in hundreds of pieces and the metal objects are sometimes shapeless blobs of corrosion. To facilitate the restoration of bowls and vases, the museum workers have a neat trick with a sandbox. As the work of art assumes form, it is jabbed down into the sand which holds it upright and steady, but enables it to be shifted instantly to any desired position.

Finally the art detectives have to deal with the most numerous criminals of the art world—insects, particularly termites which may eat through any wood object until it crumbles at a touch without showing a sign of their activities on the surface.

Every wooden object to be placed on exhibition is first introduced into a "death chamber," a glass container into which fumes of carbon tetrachloride are released, killing all insects and larvae. The same process is applied to ancient books.

So, year by year, the art detectives improve their methods until they are chemists, photographers, historians, art experts, upholsterers, carpenters, vermin eradicators, X-ray technicians, puzzle adepts, as well as accomplished artists with brush and pen in their own right.

Russia's Messengers of Death

(Continued from page 37)

Sniper Mikhailov who had tried in vain to track down a certain German sniper. Finally Mikhailov called a trench-mortar crew to his aid, asking the trench mortar gunners to send several bombs in the direction of the enemy sniper. When the first bombs burst, the German sniper hurriedly changed his position. This was just what Mikhailov had been hoping. With one bullet, the Russian got the German.

Legends have sprung up around the most renowned Russian snipers. Many citizens refused for a long time to believe that Lieutenant Pavlichenko was a girl, because of her amazing prowess as a sniper.

"My first experience against the enemy is one I shall never forget," says Lieutenant Pavlichenko. "My turn came to occupy the firing position. I lay there and watched the Rumanians digging themselves in only three or four hundred yards away. We were strictly forbidden by the commander to shoot without his permission. I passed the word down the line, 'May I fire?' and waited. The commander sent back the

(Continued to page 152)



Lifeline to Alaska

1600 miles across rivers and through forests... over mountains and muskeg... in 9 months U. S. Engineers create the Alcan Highway... and Evinrudes were on the job!

"Impossible... fantastic... monstrous," said the critics. Towering mountain ranges, vast wilderness, great rivers, every obstacle known to road builders blocked the way. A fraction of the project could easily take years to complete.

In March the Corps of Engineers swung into action. Miracles were demanded — and accomplished. The world knows only the results. In December the Alcan Highway was through! The lifeline for Alaska's defense and America's safety stretched securely from Dawson to Fairbanks, and trains of freighter trucks were rolling the length of it!

Alcan is a military highway now...

but some peaceful summer to come you may decide to try your fishing luck in sporty lakes and rivers up near the Arctic Circle! Swiftly covering these spectacular miles you'll gain fresh appreciation of the greatest road building accomplishment in history!

We're proud that Evinrudes served on *that* job... and equally proud of the Evinrudes that are faithfully performing many another wartime task for the army, navy and marines. Until Victory, Evinrudes are being built only for the armed services... then there will be brilliant new Evinrudes for peacetime pleasures again!

EVINRUDE MOTORS, Milwaukee, Wis.

Evinrude Motors of Canada, Peterboro, Canada



★ To speed the day of peace... buy MORE War Bonds.

EVINRUDE

OUTBOARD MOTORS

To my car owner friends:

I ought to know something about automobile engines, for my company enjoys a tremendous piston ring business.

We know the car owner is careful of his car. That's because it's the only car he will have for a long, long time.

Today it isn't enough just to care for the tires. After all, it's the engine that makes a car go. It must be kept in tip-top shape, so it will last ... and last ... and last.

We build our Hastings Steel-Vent piston rings for just such long-lived service. And also to save oil and gas, and check cylinder wear.

Most any motor service man will bear this out and be glad to install Steel-Vent rings for you. You can depend on Steel-Vents, and it will pay you to insist upon them.

The Tough Guy



HASTINGS

STEEL-VENT PISTON RINGS

*Tough on Oil-Pumping
Gentle on Cylinder Walls*

question: 'Are you sure of hitting them?' 'Yes,' I said. 'Then fire,' he answered.

"I got a grip on myself, forced myself to be cool, took careful aim and fired. My Rumanian flung up his arms and dropped. I waited for a fraction of a second. Another head appeared over the top. I got that one, too. That was my baptism of fire.

"Snipers' work is not easy. You go out in the dark, at four a.m., and you come back late at night. You need self-control, will-power and endurance. Every step a sniper takes is under the observation of enemy snipers, whom we call spotters. They try to mark our firing positions and keep these positions under machine gun and artillery fire. That is why each of us has several firing positions. I am never more than two days at the same position. You should shoot only when you are certain of your aim, for every unnecessary shot gives away your position.

"It was the German snipers who taught me caution, endurance and restraint. If I so much as stirred a finger, a bullet would whistle just over my head, or at the back of my legs. Occasionally a German tin hat would appear, just a fraction of it. I would think: 'I'll get that Fritz!' You fire and the tin hat waggles like the head of a toy elephant, and disappears. It was only a German decoy to make the sniper betray his position. Following that, the Germans usually opened such a squall of fire that you dared not even raise your head. It was just terrible. From sheer fright you would call out: 'Machine gunners! Save me!' Then the gunners would open fire, quiet the Germans down a bit, and you would be able to crawl back, more dead than alive, for a breathing space. After a while, a sniper becomes less panicky and learns the German secrets as well as how to keep his position a real secret."

At snipers' schools throughout Russia, they are fond of repeating tales of the heroism of snipers. A favorite concerns Section Commander Snezhko, and Red Army men Yelkin and Oreshnikoff, who reconnoitered the location of enemy "cuckoos" and then undertook to destroy them. Snezhko went to the left, the others to the right. They had to lie in the grass, camouflaged, while the enemy "cuckoos" fired from their positions in a fir tree. Snezhko was wounded on the first shot but he killed one of the "cuckoos" in retaliation. The other two men figured out that there were "cuckoos" in the other trees and after careful aim they eliminated the entire "nest."

And, while the young men and women of Russia are the expert snipers, and the new

(Continued to page 154)

WHEN A FELLOW NEEDS A BINOCULAR...



"Hold it, boys! Those devils are up to something"... Naked eyes might never have seen the danger. A whole detachment might have walked into death. Thank heaven, ONE pair of eyes in this group was NOT naked!

Wars have always been full of tricks and surprises, but your boy today is facing the trickiest and most ingenious enemies in history. Countless times, he may owe his life to the fact

that his binoculars are constantly on the watch. Universal is proud to be one of a few manufacturers now making binoculars for our Army, Navy and Marines and The United Nations.

This work has led Universal to pioneer in many ingenious new methods of production—significant and permanent contributions to America's future leadership in the manufacture of precision optical instruments.



BEFORE HE LAYS THAT WIRE! A man at work is an easy target for a hidden enemy. This U. S. Army Signal Corps man is trained to survey the terrain carefully with binoculars,



*There's only one flag
we're prouder of!*

**REMEMBER YOUR
PLEDGE TO BUY
WAR BONDS, AND
LIVE UP TO IT!**

UNIVERSAL CAMERA CORPORATION

NEW YORK • CHICAGO • HOLLYWOOD

Makers of Precision Photographic and Optical Instruments

PEACETIME MANUFACTURERS OF CINÉMASTER, MERCURY, CORSAIR CAMERAS

TO KNOW YOU'RE RIGHT

use MILLERS FALLS Precision Tools

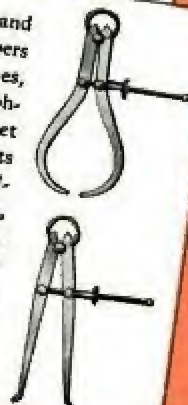


DESIGNED to make accurate depth measurements of holes, slots, shoulders, and projections, the Millers Falls Depth Gauge is a rugged, precise shop tool. Spindle movement one inch, capacity 0 to 3" by .001"; capacity may be increased up to 12 inches with Millers Falls hardened and precision-ground extension rods. Several special features insure accuracy and long wear — standard Millers Falls extra quality.



TO MEET constant demand, Millers Falls micrometer production has been increased several hundred percent during this war. Typical Millers Falls quality, these are largely in the manufacture and repair of war goods, they'll also be needed in huge quantities for production and maintenance in the mechanized world of tomorrow. Plan now to "tool up" with Millers Falls quality micrometers.

THERE ARE 64 kinds and sizes of Millers Falls calipers and dividers — 3 to 12 inches, inside, outside, and hermaphrodite. All are designed to meet the most exacting requirements of skilled machinists and tool-makers. Made of crucible steel, with rounded edges, hardened, ground, and polished. Many features for accuracy, rigidity, and convenience. Millers Falls' 75 years of tool-making "know-how" shows in these quality tools.



MILLERS FALLS TOOLS

SINCE
1868

MILLERS FALLS
COMPANY

Greenfield, Mass.
U.S.A.

methods of fighting have led to the discovery of better and better lenses for sniping-guns, still the older people have valuable advice to give. One of these patriarchs, Ivan Gerasimovith Kandryuchev, a bearded and white-haired Cossack, makes these observations:

"To a coward a bee is a bullet. You must learn to read the earth out on the steppes, on the white pages of snow. You must learn to see the tracks of the hare and marks left by the fox's tail. You must learn the broad paw marks of the wolf. Just let the enemy come out of his nest, out into the open. Take it easy, aim carefully and squeeze the trigger at the right moment. Then you will not fail."

The Sky's Not the Limit

(Continued from page 69)

has climbed toward the stratosphere carrying test equipment and test crews in search of data that may be used in designing aircraft capable of flying safely at even greater heights. Down on the ground, data of the same kind have been collected with the aid of Boeing's test chamber in which various conditions of pressure, temperature and humidity from sea level to the stratosphere can be reproduced scientifically. The chamber is used in the development of high-altitude equipment, and the use of oxygen and emergency equipment is taught men who will actually fly sub-stratosphere airplanes.

In that chamber, or perhaps in the "flying laboratory," will come the discovery of just how high man will be able to fly. Some scientists assert that 43,000 feet is the ultimate, others believe 43,000 feet is only the limit for existing equipment. Improvement of the pressurized cabin and engine supercharging may enable tomorrow's aircraft to climb to 50,000 feet.

A wartime product that gives more than a hint of things to come is Lockheed's four-engine transport, the Constellation—largest, fastest and most powerful land-based cargo or transport plane. Driven by an 8,000-horsepower installation, it will fly a light tank and its complement of troops across an ocean at a top speed comparable with the cruising speed of fighter planes. It is faster than the Japanese Zeros or any four-engine bombing plane now in active service. It is capable of spanning the American continent in less than nine hours, or of flying from California to Honolulu in 12 hours. In peacetime it could carry 55 passengers and a crew of nine nonstop from Los Angeles to New York in record

(Continued to page 156)

Out of a G-E engineer's home workshop . . .

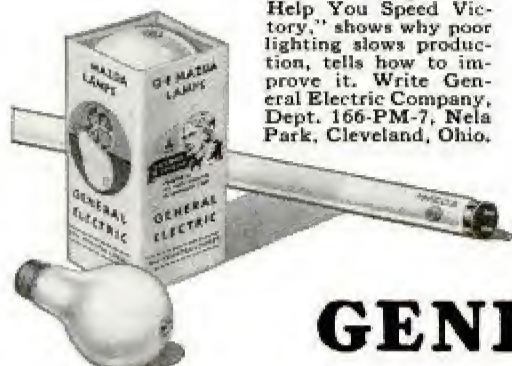


A. P.—ALL RIGHTS RESERVED

Bomb indicator lamps (shown twice actual size at the right) on the instrument panels of this AT-11 Beechcraft Bombing Trainer tell the bombardier how many bombs have been released and how many remain.



FREE! 20-page booklet "How Light Can Help You Speed Victory," shows why poor lighting slows production, tells how to improve it. Write General Electric Company, Dept. 166-PM-7, Nela Park, Cleveland, Ohio.



THE Army asked General Electric for a tiny lamp to signal "bombs away." A lamp that would produce a light of a distinctive color. Idea for the solution came to a G-E engineer when he noticed the translucent plastic handle of a kitchen paring knife on a workbench in his attic workshop. Cutting off the tip of the handle, he produced a dome-shaped, colored plastic cap, which he fitted over the tiny G-E grain-of-wheat bulb used in surgical instruments. This lamp, after weeks of intensive experiment in G-E laboratories, served as the model for the thousands of bomb indicator lamps now in use on U. S. bombers.

ONE OF 150 SPECIAL LAMPS. This is only one of more than 150 G-E lamps that have been developed to meet specific military needs since the war started, and one of hundreds of types of special lamps G-E is making for military service. These include everything from lamps for submarines and battleships to those in tanks, jeeps, and aircraft.

ONLY PART OF THE JOB. Making special lamps for the armed forces is only one of G-E's wartime lighting jobs. Eliminating glare, gloom, and shadows in war plants, big and small, is another. Your nearest G-E lamp office, your G-E lamp supplier, or your electric service company will gladly supply helpful advice to any war plant.

G-E MAZDA LAMPS

GENERAL  ELECTRIC

Tune in the G-E MAZDA lamp radio program Sunday at 10 p.m. (Eastern War Time) N.B.C.



Raiding with the Rangers, 'cross country scouting, front line dispatch riding... those are some of the motorcycle jobs that call for red-blooded riders with daring and courage, cool heads and resourcefulness.

In flashy, flexible performance on a dozen battle fronts, Indian Motorcycles are backing up these riders with all of Indian's famous power and speed and sturdy dependability. The soldier who rides an Indian knows there's no safer motorcycle built.

And you'll know it, too, when you ride the great new Indians that will be yours for good times and economical transportation after this war. In the meantime, let your Indian dealer help keep your present motorcycle in fighting trim... and ask him about his reconditioned "buys".

INDIAN MOTORCYCLE COMPANY, SPRINGFIELD, MASS.



BUY WAR BONDS NOW

★ ★ TO BUY AN INDIAN LATER ★ ★

time, flying at 20,000 feet above 90 percent of all weather disturbances. Yet, the passengers would suffer no discomfort, for the pressurized cabin, heated or cooled according to climate and always air-conditioned, maintains the air density of the 8,000-foot level. The plane can rise comfortably to 35,000 feet. A 25,000-foot altitude can be maintained on three engines and a 16,500-foot level on only two.

Robert E. Gross, president of Lockheed Aircraft Corporation, has this comment: "I believe this airplane is the greatest contribution to air transit yet made by Lockheed. It is happily timed for the war cargo emergency which confronts us, and for the reconstruction to follow the victory."

Burdette S. Wright, vice president in charge, Curtiss-Wright Airplane Division, recently made this announcement:

"Curtiss-Wright engineers have projected a research laboratory destined to become one of the nation's largest and best-equipped workshops, to anticipate the needs of the world in war and in peace for the manufacture and operation of vast fleets of fighter planes, cargo transports and passenger airliners of the future.

"Altitude tests can be made in an altitude chamber accommodating single-place fuselages. Actual dive and climb conditions can be reproduced. The most costly equipment in the laboratory will be the wind tunnel, one of the largest in the nation. There also will be facilities with which completely assembled aircraft can be statically tested in an area large enough to accommodate ships of the C-46 class."

The C-46 is the huge twin-engine cargo-carrier Curtiss-Wright developed for the Army. Curtiss-Wright now is busy on a cargo carrier—a military "workhorse"—that will be constructed mostly of wood.

From these, and scores of other developments, may be gained some idea of what the leaders of American aviation mean when they assert that the surface has hardly been scratched, that tomorrow will bring many new wonders in the flying game.

Mosquito Blitz

(Continued from page 85)

times 31,000,000 mosquitoes, or 13,000,000,000. Thirteen billion mosquitoes would tip the scale at 26 tons, equal to the weight of five elephants. Distributed over a 10-mile radius there would be 1.4 mosquitoes per square foot, or 32,000 mosquitoes for each of the 410,000 residents in the district. If half of the mosquitoes were females—the only ones that bite—that would leave

(Continued to page 158)

Your Camera of Tomorrow

Although right now we are building for the Future, all our energies at the moment are concentrated on the protection of that Future by the manufacture of Precision Optical Instruments and Communication Radio Systems for our Armed Forces. . . . Out of the Crucible of War will come new ideas, new materials and new methods. Thus we are also building for you. . . . The apprenticeship we are serving under the taskmaster of war needs, is streamlining our designs, stimulating our ideas and strengthening the skills of our hands—These Jewels of Today will make finer Instruments and better Cameras for you Tomorrow.

"Jewels of Today" is one of a series of advertisements appearing in several of the leading national magazines . . . to acquaint the people of America with Argus products . . . in war and peace.



C3
The Argus that made camera history

Learn more about composition—lenses—film—and helpful hints for using any camera. Send 25c today for the 56-page book "Good Pictures"

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ARGUS EYES FOR VICTORY



MILITARY OPTICS
BY

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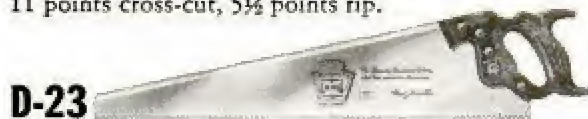
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CAMERAS
•
PRECISION OPTICAL
INSTRUMENTS
•
AVIATION RADIO
EQUIPMENT
•
BUY WAR BONDS

SAWS FOR THE WAR EFFORT

In accordance with WPB limitation order, Disston is manufacturing four Disston Hand Saws and two Keystone made-by-Disston Hand Saws as shown below... If you are doing essential work, see your Hardware Dealer about one of these fine saws:



D-43 Victory—Lightweight Straight-back pattern, the finest saw in the Disston Line. Made in 26-inch 7, 8, 10 and 11 points cross-cut, $5\frac{1}{4}$ points rip.



D-23 Lightweight Straight-back pattern. Always popular with saw users demanding quality and workmanship. Made in 24-inch 8 and 10 points cross-cut; 26-inch 7, 8, 10 and 11 points cross-cut, $5\frac{1}{4}$ points rip.



D-8 Medium weight, Skew-back pattern, "The Saw Most Carpenters Use." Made in 20-inch 10 points cross-cut; 22-inch 8 and 10 points cross-cut; 24-inch 8 and 10 points cross-cut; 26-inch 7, 8, 10 and 11 points cross-cut, $5\frac{1}{4}$ points rip.



D-7 Lightweight Straight-back pattern. Universally popular moderately priced Disston quality. Made in 26-inch 7, 8, 10 and 11 points cross-cut, $5\frac{1}{4}$ points rip.

K-6 Challenger, a popular priced Keystone made-by-Disston Skew-back saw. Made in 26-inch 8 and 10 points cross-cut, $5\frac{1}{4}$ points rip.

K-4 Airmaster, a popular priced Keystone made-by-Disston Straight-back saw. Made in 26-inch 8 and 10 points cross-cut; $5\frac{1}{4}$ points rip.

MAKE TOOLS LAST with the help of the instructive Disston Saw, Tool and File Manual—FREE from your hardware dealer, or write to us for your copy.

HENRY DISSTON & SONS, INC.
711 Tacony, Philadelphia, Pa., U. S. A.



16,000 potential bites per person. It is fortunate, says Mr. Clarke, that mosquitoes also bite birds and field mice.

Data on the flight habits of mosquitoes are now being used by health officers in studying epidemics such as infantile paralysis and sleeping sickness.

Prevention projects carried on by the Des Plaines group include the draining of marshes, removal of polluted dumps and the transformation of polluted streams into clean water that will support larvae-eating fish and insects. One polluted canal 60 feet wide and four miles long contained an estimated 600,000,000 larvae.

Despite the success of mosquito control in isolated regions similar to the Des Plaines district, there are less than 100 abatement districts in the United States. This is exclusive of the southern malaria belt where mosquito abatement is handled by full time county health officers. Only a handful of states have passed enabling acts that permit the organization of mosquito control districts.

The cost of maintaining the Des Plaines Valley Mosquito Abatement district is \$40,000 a year and the tax assessment is one-half mill on the dollar. The model Des Plaines Valley setup includes the director, general foreman, four sectional foremen, laboratory technician and 17 field workers. A board of trustees consists of five civic minded citizens who serve without pay. Residents of this district, who once played golf with mosquito netting over their heads and hid behind screens in the evening, no longer kick about the added assessment.

A conservationist once asked Mr. Clarke if he knew of any good use for mosquitoes aside from providing a larvae meal for a minnow.

"There is a very useful Solomon Island mosquito," he said. "This is a special mosquito that bites a Jap sniper, spoiling his aim. Aside from that, I know of no possible use for the pests."

Arming for the Knockout

(Continued from page 5)

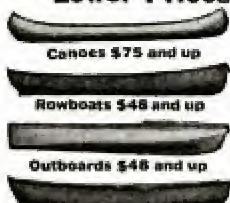
Some months ago we were having difficulty in getting a pair of precision pins in our howitzer department. We had let the job out to three contractors, but they had been unable to produce pins meeting the fine tolerances. One of our employees, who had a work shop in the basement of his home, volunteered that he believed he could do the job. A trial proved that he was right and he was awarded a contract

(Continued to page 160)

Thompson BEATS the World on BOATS



**Better Built
Lower Prices**



Canoes \$75 and up

Rowboats \$48 and up

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**Safe Boats With
Full Length Spray Rails**

Keep passengers perfectly dry—even at high speeds. Catalog also shows today's seven most popular models of sailboats. Two big factories. Prompt shipment.

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Light "Car-Top" Boat
THOMPSON BROS. BOAT MFG. CO. (114)
113 Elm St.
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New Designs in FRANZITE GRIPS

Modernize Your Gun! Improve Your Score!

Most durable grips made. Positively unbreakable! For Colt, Smith & Wesson, Hi-Standard, Ortgies, Luger & Mausers in a wide choice of beautiful designs in ivory, pearl, walnut, onyx, etc. Low prices. **FREE CATALOG.** Dealers Wanted.

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Sani-Flush 10c and 25c sizes
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New
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REAL ENGINE VALUE



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GHQ MOTORS, Dept. BT, 40 East 21 St., New York, N. Y.



Falls Tree—Cuts Log

Fits rear power take-off shaft.

Drive thru gear reduction. 18-in. stroke, 10-ga. blade. Economical, saws to profit.

**FREE Circular
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OTTAWA MFG. CO., D727 Forest Avenue, OTTAWA, KANSAS

OTTAWA TRACTOR SAW



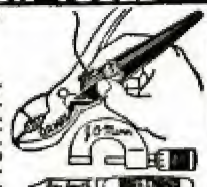
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help your tools last longer and to perform better. Free Catalog for Toolmakers and Machinists.

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443 Columbia St. Dayton, Ohio

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Write with electricity any name or design on the hard-est and finest tools and instruments or any metal, like writing on paper with pen or pencil. Thousands used by mechanics, garages, machine shops. **Complete Outfit \$3.50—Prepaid Anywhere** Interzone Illustrated circular free. Write today. **ARKOGRAF PEN CO., 3927 S.E. Stark St., Portland, Ore.**



When Worming for Tape,
Round (ascaris) and Hook Worms

You Cannot Worm Your Dog WRONG



—you're sure to worm right if you follow the easy picturized directions with Pulvex (the combination treatment) Worm Capsules. Here's why:

Your dog can have Tape, Round (ascaris) and Hook Worms, any or all, at the same time! To worm for all three **AS YOU ALWAYS SHOULD, especially tape-**

worms, YOU MUST USE 2 TYPES OF CAPSULES. No single-type capsule can expel those three worms. You definitely expel them (including tapeworms) when you use the 2 types of capsules, to be given a few days apart, in the Pulvex Combination Treatment Worm Capsule package.

Worm right; avoid worming wrong for those worms; use Pulvex Capsules. Packaged two ways: for puppies, for dogs. Either 50c. Double size package, 75c. Quantity discounts to kennels; write direct to—

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WORM CAPSULES



**Hot Meals . . . EVEN
in a "FOX HOLE"
with HEATABS
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Food calls for HEAT, wherever you are! HEATABS (Tablets of Concentrated Heat) will light instantly, and will burn long, with intense heat . . . outdoors or indoors. Campers, picnic-ers, hunters, fishermen can cook, fry, boil food, start fires under any circumstances with HEATABS. Many uses for Boy Scouts, Girl Scouts, housewives, doctors, nurses, Red Cross and Civilian Defense workers, dentists, chemists, industrial workers, etc. Important in First Aid and Emergency Kits. Carried by armed forces to heat combat rations. Solid, compact, non-poisonous . . . NO SMOKE, SOOT, FUMES or ASH!

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HEATABS

TABLETS of concentrated
HEAT

KNOWLEDGE
THAT HAS
ENDURED WITH
THE PYRAMIDS

A SECRET METHOD FOR THE MASTERY OF LIFE

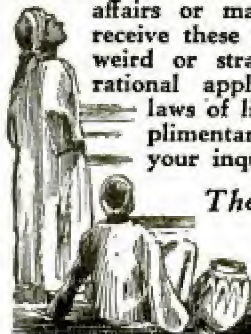
WHENCE came the knowledge that built the Pyramids? Where did the first builders in the Nile Valley acquire their astounding wisdom that started man on his upward climb? Did their knowledge come from a race now submerged beneath the sea? From what concealed source came the wisdom that produced such characters as Amenhotep IV, Leonardo da Vinci, Isaac Newton, and a host of others?

Today it is known that they discovered and used certain *Secret Methods* for the development of their inner power of mind. They truly learned to master life. This secret art of living has been preserved and handed down throughout the ages and today is extended to those who dare use its profound principles to meet and solve the problems of life in these complex times.

This Sealed Book — FREE

Has life brought you that personal satisfaction, the sense of achievement and happiness that you desire? If not, it is your duty to yourself to learn about this rational method of applying natural laws for the mastery of life. To the thoughtful person it is obvious that everyone cannot be entrusted with an intimate knowledge of the mysteries of life, for everyone is not capable of properly using it. But if you are one of those possessed of a true desire to forge ahead and wish to make use of the subtle influences of life, the Rosicrucians (not a religious organization) will send you A Sealed Book of explanation without obligation. This Sealed Book tells how you, in the privacy of your own home, without interference with your personal affairs or manner of living, may receive these secret teachings. Not weird or strange practices, but a rational application of the basic laws of life. Obtain your complimentary copy by addressing your inquiry to Scribe X.D.B.

The ROSICRUCIANS
(A M O R C)
San Jose, California



and given a weekly quota. He has turned out thousands of pins so far and has had only one rejected by the government.

In setting up our trench mortar department, another interesting example of employe ingenuity came to light. We needed three lathes for roughing, finishing and honing the interior of the barrels. We discovered it would take 18 months to have these lathes built—too long to wait for the badly needed mortars. Machine experts searched through momentarily idle machinery and rebuilt three lathes to do this work. The machines were so satisfactory that they have never been replaced.

Because railroad equipment is the first line of war offense, we have held in reserve a portion of our manufacturing facilities. We have many large orders for different types of freight cars, some for military service overseas on railroad lines totally different from those we have at home. Speed is essential in the production of cars, for delay in the delivery of railroad cars means holding up shipments of war materials. For instance, on November 6, 1942, we received an order for some cars. A sample car was ready for inspection December 1, and the cars were rolling off the assembly line by December 12.

Ore cars, built to special specifications, were needed in a hurry by the Duluth, Missabe and Iron Range railroad to move iron ore out of the northern Minnesota mining districts. This ore was badly needed for the winter war effort and cars had to be supplied to get it to the Superior-Duluth shipping points before the lakes froze. An order for 500 cars was placed with us and after material became available our first car was shipped, on August 28. Five weeks later, October 5, the 500th car left our Michigan City plant, in time to get them all into service and help in the great job of moving the record of more than 92,000,000 tons of ore from this territory. Our basic overall capacity is sufficient to permit us to build freight cars in existing carbuilding shops at the rate of one every 3½ minutes. Last spring, despite the shortage of materials, we were producing at the rate of one car every 4½ minutes.

In addition to the items previously mentioned, Pullman-Standard is making bombs for the army and weldments for anti-aircraft guns. All production-speeding techniques are shared with other manufacturers. With this kind of teamwork America's mighty industrial empire will soon have the cumulative output of war tools which will crush the enemy.

¶ To learn where to buy commercial products described in these pages, see the index.



TANKS

32 Large Pictures of **25c**
U.S. Army Tanks ready for framing, only

Start a collection of the most fascinating land battle-ships in the world—U. S. Army Tanks. Know the difference between the M4—M7—M9. See the special half track General "Old Blood & Guts" Patton uses. Pictures are beautifully printed on heavy glossy paper in size 8½ x 5½ ready to frame or put into your album. Clearness of prints brings every detail showing guns, armor, and size. Don't miss this unusual offer—mail coupon today—buy a set for yourself—buy for your friends—they will want them too.

Send 25c in stamps or coin for each set to
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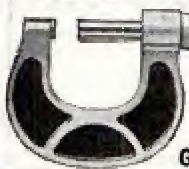
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Someday—you can drive again! Then you will want a dependable guide in your car—the HULL STREAMLINE COMPASS—now made exclusively for U. S. Army vehicles. Wartime engineering will provide even improved performance.

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0-1" reading in 1/1000"

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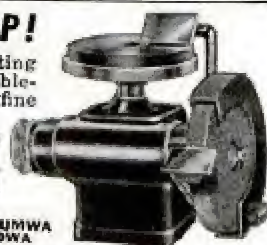
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GRIND and oilstone your cutting edges on this versatile tool. Double-face oilstone for coarse and fine honing.

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PAINT STRIPING TOOL

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With this NEW TOOL (not a brush) everyone can now draw lines with paint. Used on autos, trailers, toys, tiled walls, cabinets, furniture, linoleum floors and all home workshop projects.

As easy to use
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BEWARE OF SYMPTOMS
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ALSO EXCELLENT FOR
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Amazing Chart
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QUALIFY FOR BIG PAY—EARN A RAISE

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Dear Sir—Enclosed find 50c for Trig-Easy Chart and instructions


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Atlas

LATHES





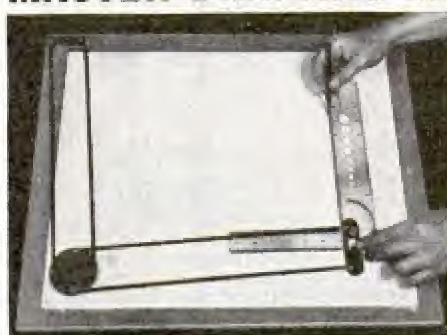
From coast to coast in the plants of the nation's famous war producers—and in many of the hard working mobile machine shops of our fighting forces—modern Atlas Lathes, Drill Presses, Milling Machines, Shapers, Arbor Presses are setting new records in precision production. Atlas Press Co., 743 N. Pitcher St., Kalamazoo, Mich.



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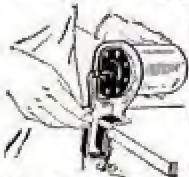
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This handy grinder does a real job of external or internal grinding. Attaches quickly to lathe or shaper and is easy to build from our well-engineered prints. Patterns loaned if desired. Four inch dia. wheel, driven by standard 1/2 H.P. motor. Includes special arbor for internal grinding. Machine worth \$200. Full set, 22 prints, \$5.00. Postage paid. Write for particulars.

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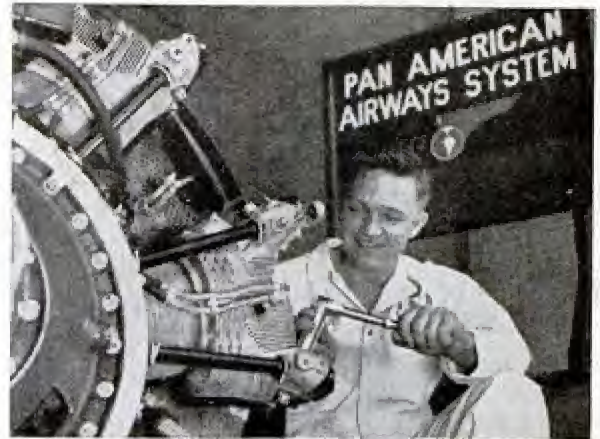
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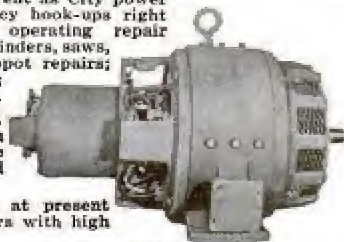
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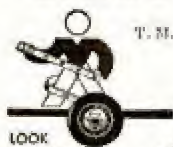
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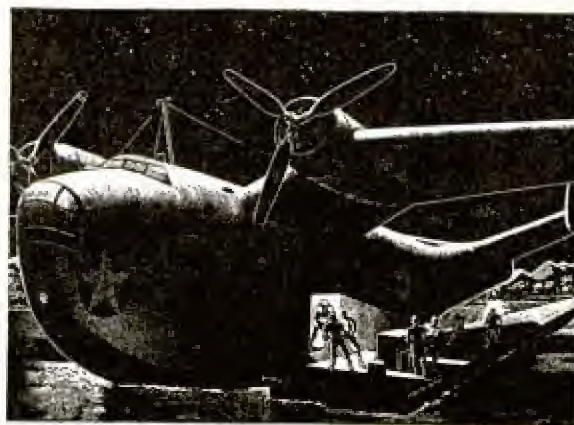
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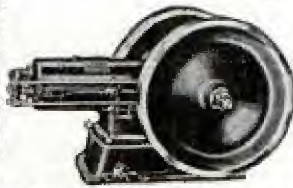
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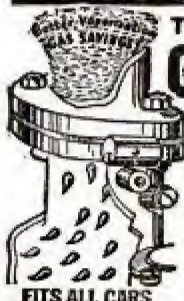


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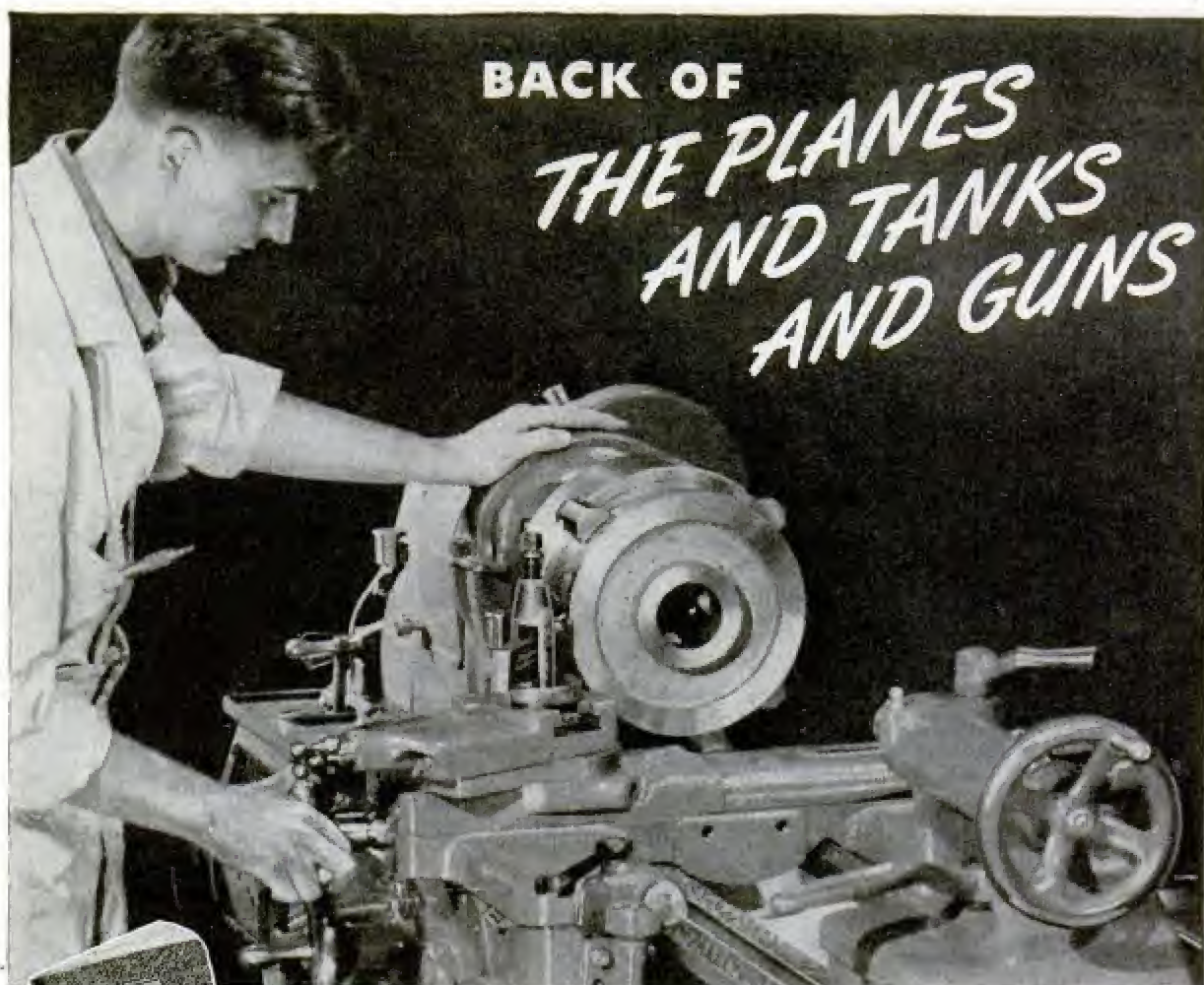
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